[COMMITTEE PRINT]

82D CONGRESS
1st Session

SENATE

INVESTIGATION OF THE PREPAREDNESS PROGRAM

TWENTY-SEVENTH REPORT

OF THE

PREPAREDNESS SUBCOMMITTEE OF THE COMMITTEE ON ARMED SERVICES UNITED STATES SENATE

UNDER THE AUTHORITY OF

S. Res. 18
(82d Congress)

TUNGSTEN
1951

Printed for the use of the Committee on Armed Services

UNITED STATES
GOVERNMENT PRINTING OFFICE
85785 WASHINGTON : 1951

DOCUMENTS EXPEDITING PROJECT

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LETTER OF SUBMITTAL

UNITED STATES SENATE,
COMMITTEE ON ARMED SERVICES,
July 5, 1951.

MY DEAR MR. CHAIRMAN: There is submitted herewith a report of the Preparedness Subcommittee which was appointed by you under the authority of Senate Resolution 19 of the Eighty-second Congress for the purpose of exercising a continuous watchfulness over matters within the jurisdiction of the Armed Services Committee through a continuous study of all policies, programs, activities, operations, facilities, requirements, and practices of the Department of Defense, the armed services, and other agencies exercising functions relating to them and the administration thereof in all respects.

This is a report on the adequacy of the Nation's supply of tungsten.

The subcommittee also has underway numerous other studies. The results of these studies will be reported to you as they are completed.

Respectfully,

LYNDON B. JOHNSON,
Chairman, Preparedness Subcommittee.

CONTENTS

	Page
I. Introduction	1
II. Nature and uses of tungsten	2
III. World sources	3
IV. Production imports and consumption of the United States	4
V. World War II experience	5
A. Stockpiling activities	5
B. Latin-American program	6
C. Domestic program	7
1. Purchase depots	7
2. Purchase commitments	7
3. Salt Lake City chemical treatment plant	8
4. Government controls	8
5. Financial assistance	8
6. Termination of program	9
7. Renewed demand in 1945	9
D. Appraisal of World War II tungsten program	9
VI. Present tungsten situation	10
A. Relation between requirements and supply	10
B. Status of national stockpile	11
1. Inadequate objectives	12
2. Inadequate procurement	13
(*a*) Quantitative	13
(*b*) Specifications	14
3. Stockpiling intermediate products	17
(*a*) Ferrotungsten	19
(*b*) Tungsten carbide or metal powder	20
(*c*) Action taken by Munitions Board	20
C. A new process for making tungsten carbide	22
D. Post-Korean problem	25
1. Legislative authority	26
2. Delegations of authority	26
3. Action taken pursuant to delegations of power	27
(*a*) Conservation of tungsten supplies	27
(*b*) Increased domestic production	27
(1) Price ceilings	28
(2) Floor price plan	29
(3) Loans and loan guaranties	31
(4) Exploration and development loans	31
(5) Appraisal of domestic production program	32
(*c*) Foreign procurement	33
(1) Procedures under Defense Production Act	33
(2) Procurement activities	34
(3) Price problems	34
(4) World allocation	35
(5) Appraisal of foreign program	35
VII. Summary and conclusions	36
VIII. Recommendations	39

APPENDIXES

A. World production of tungsten ores by countries, 1905–48, in metric tons of concentrates containing 60 percent WO_3	40
B. Price of tungsten per short ton unit of WO_3, January 2, 1947, to January 11, 1951	46
C. Circular, dated May 8, 1942, containing details of Metal Reserve Company's World War II domestic tungsten program	46
D. Tungsten stockpile specifications	50
E. Study of tungsten ore reserves of the United States, prepared by the Bureau of Mines and the Geographical Survey	51
F. General Service Administration's press release and regulations pertaining to the domestic tungsten purchase program	52

TUNGSTEN, 1951

I. Introduction

On occasion the operations of some of the Federal agencies bear an unfortunate resemblance to a children's game of blind man's buff—with all the players blindfolded.

Two or more bureaus with separate but related functions will grope for each other in the dark. They will stumble over obstacles, paw at thin air, or just stand still in bewilderment. Usually, they get farther and farther apart as their search for each other becomes more frantic.

Finally, somebody is tagged as "it" and the blindfolds are removed for a few precious minutes of daylight. It is then discovered that what the players have tagged is the public welfare. When the agencies are defense agencies, "it" turns out to be the Nation's security.

Such is the story of tungsten.

Here were two agencies—the Munitions Board and the Department of the Army. Each was the child of a parent organization—the Nation's Defense Establishment. Each had an important defense responsibility involving a vital metal—tungsten. Each had the clear obligation to work together for the national security.

Yet, though both were housed in the same building, these two agencies, so far as tungsten problems were concerned, acted as though they had never been introduced. They might as well have been separated by impenetrable barriers and thousands of miles, instead of thin partitions and a few steps down a corridor.

The Army had an important program—the development of armor-piercing shells—which required large amounts of tungsten. The Munitions Board had the responsibility of stockpiling the metal lest America's supplies be suddenly cut off.

It would be difficult to picture a situation crying more loudly for the closest cooperation. The armor-piercing shell development—the so-called core program—was a foundation stone of the Nation's military plans. The stockpiling was absolutely essential since the major sources of tungsten were overseas—particularly in China—and could readily be cut off.

The two agencies had merely to get together, decide how much was needed, and ask Congress for the appropriations.

And yet, for nearly 3 years no one—absolutely no one—informed the Munitions Board of the amount of tungsten required for the Army's core program and the Board made no effort to find out about it. The two agencies seem to have been playing "blind man's buff."

Meanwhile, nobody was storing up tungsten.

When they finally got together, it was too late. China, the principal source, was just about ready to fall into the hands of the Communists.

Even then, they acted as though time were something not for action. The program for stockpiling tungsten merely stepped up from a

crawl to a shuffle. For nearly 2 years, the agencies planned to make plans but rarely took any action.

Today, the United States and the free world stand on the verge of tungsten starvation. Production can be increased; more efficient methods can be found; nonessential uses can be slashed ruthlessly. But the fact remains that no foreseeable eventuality will provide all that is needed by the European democracies and the Americas to meet their essential civilian and military requirements.

This sad plight can be traced largely to the game of "blind man's buff" played by the Munitions Board and the Army.

Mr. John D. Small, present chairman of the Munitions Board, took office on November 15, 1950, and, therefore, is in no way responsible for the stockpiling derelictions discussed in this report. Since the date of his appointment, there is substantial evidence that Mr. Small has made considerable progress in placing the Board's operations on a sound basis.

II. Nature and Uses of Tungsten [1]

"Tungsten is still the hardest metal yet made use of by man" and its melting temperature (3410° ± 20° C.) is the highest of all known metals.[2] These two characteristics combine to make tungsten one of the most important metals in our industrial and military life.

The products of tungsten, being heat-resistant, retain their form at extremely high temperatures. Tungsten is also highly resistant to wear, corrosion, and acid.

Quantitatively, the principal use of tungsten is in the manufacture of tools for cutting metal. The most widely used of these cutting tools are the high speed steel tools, the most popular of which contains 18 percent tungsten, 4 percent chromium, and 1 percent vanadium—commonly known as "18–4–1". Cutting tools are also made from tungsten alloyed with other metals; and tungsten carbide cutting tools are increasing in popularity because they are more economical and productive than high speed steel tools.

The most generally known use of tungsten is for filaments in electric lights. It is also used in electronic equipment, switch gear, welding rods, contact points and X-ray targets. Tungsten salts are used in chemicals, pigment, and tanning industries. It appears in saws, razor blades, watch springs, and numerous other items.

Militarily, tungsten is used in jet engines and as cores in high velocity armor-piercing projectiles. Atomic energy work also requires tungsten.

The above-described uses of tungsten reveal its importance in our Nation's life. The National Production Authority advised this committee that about 65 percent of the tungsten consumed in the United States is used to make tungsten alloy steel, 25 percent to make tungsten carbide and other alloys, and 10 percent is used in chemical, electrical, and miscellaneous items.[3]

It is pertinent to note that in World War I apparent consumption of tungsten in the United States of America rose very rapidly, increasing from 3.5 million pounds in 1913 to an average of 9.6 million pounds in 1915–19. In relation to output of steel, the use of tungsten per 1,000 tons of steel ingots produced was about 100 pounds in 1913 and

[1] Chemical symbol W.
[2] Tungsten, K. C. Li and Chung Yu Wang (1947). Mr. Li is considered by many in the tungsten industry as being the foremost world authority on tungsten.
[3] Letter dated February 1, 1951, to Mr. Donald C. Cook, Chief Counsel.

over 200 pounds in 1915–19. Between the First and Second World Wars the use of tungsten relative to steel receded to relatively low levels, reflecting world disarmament and greater efficiency in the use of tungsten.[4] In the 5-year period 1935–39, apparent consumption of tungsten was 5.2 million pounds, or about 110 pounds per 1,000 tons of steel. During World War II (1941–45) actual consumption, as calculated by the United States Bureau of Mines rose to an average of 17.3 million pounds, reflecting a use of over 200 pounds of tungsten per 1,000 tons of steel. In the postwar period 1946–49, consumption approximated 7 million pounds per year or less than 90 pounds per thousand tons of steel.

It is clear from the foregoing that tungsten, in addition to being a peace-time necessity, is a "war baby," that is, its usage while fluctuating with general industrial activity, increases abnormally in war periods.

III. World Sources

Tungsten ores are found in many areas of the world—but in greatly varying quantities. The ores fall into two groups: the wolframite group and the scheelite group. The wolframite group is composed of (1) ferberite, an iron tungstate ($Fe\ WO_4$), containing not more than 20 percent hubnerite; (2) hubnerite, a manganese tungstate ($Mn\ WO_4$), containing not more than 20 percent ferberite; and (3) wolframite containing all proportions between 20 percent ferberite and 80 percent hubnerite, and 80 percent ferberite and 20 percent hubnerite.

The scheelite group contains only one economically important mineral, scheelite, a calcium tungstate ($CaWO_4$).

Since 1918 China has been the dominating factor in world production, having supplied 28 percent of the world total between 1905 and 1948. The United States is second, having supplied 13 percent, and Burma third with about 13 percent. Bolivia, Portugal, and Korea follow in the order named.[5]

Because of the purity of her ores, vast deposits and low production costs, the Chinese production is also the dominant factor in determining price. Chinese reserves are reported [6] as being 1,865,798 metric tons containing 60 percent WO_3,[7] whereas the reserves of the rest of the world are estimated as only 367,000 short tons 60 percent WO_3.[8] It has also been reported that "given adequate power and machinery China can supply the whole world's requirements of tungsten at a remarkably low price."[9]

As may be noted from appendix A, world production fell from its peak of 60,000 metric tons, 60 percent WO_3 in 1943 to 18,900 metric tons, 60 percent WO_3 in 1946 and then increased in 1947 and 1948. However, it should be noted that the Far East production is almost entirely responsible for these increases. No detailed figures are available as to world production for 1949 and 1950. However, judging by the trend of prices and United States output, world production fell off in 1949.

The following table summarizes world production by areas for selected years:

[4] Cf. Tungsten, op. cit. pp. 238-240. It is also likely that the use of war accumulations of iron and steel scrap containing tungsten reduced consumption of primary tungsten in the first few years following World Wars I and II.

[5] See appendix A for production by countries since 1905.

[6] Tungsten; K. C. Li and Chung Yu Wang (1947).

[7] Approximately 1,960,000,000 pounds.

[8] Approximately 360,000,000 pounds.

[9] Chang, T. Y., Modernization of Chinese Mining: Am. Metal Market, vol. 53, No. 6, January 9, 1946, p. 5.

Tungsten: World production by areas (metric tons 60 percent WO_3)

	1929	1939	1943	1944	1945	1946	1947	1948
North America	764	4,122	11,977	9,879	5,163	4,806	3,279	4,618
South America	1,693	4,823	11,281	12,837	7,633	4,710	4,576	4,015
Europe	718	5,182	12,934	8,256	2,312	3,445	5,891	6,268
Africa	28	663	2,030	2,112	1,354	701	940	624
Asia	12,321	26,437	20,821	15,293	5,155	4,144	10,702	16,860
Oceania	287	1,078	1,029	843	1,185	1,071	1,156	1,255
World total	15,811	42,305	60,072	49,220	22,802	18,877	26,544	33,640
Asia, percent of world	78	62	35	31	23	22	40	50
World ex-Asia and U. S. S. R.	3,490	15,568	38,351	32,927	16,347	13,233	14,342	15,280

NOTE.—1 metric ton of 60 percent WO_3 is equivalent to 1,048.95 pounds of contained tungsten (W).

From the foregoing it is clear that the major tungsten resources of the world and a major portion of current world output are based in Asia. It is significant that output outside of Asia and the U. S. S. R. in 1948 was at about the prewar level. It is also worthy of note that production in other areas rises rapidly in periods of high prices such as were witnessed in 1943 and 1944, indicating the relatively marginal character of most non-Asiatic production.

IV. Production, Imports, and Consumption of the United States

Although the United States ranks second in total world production, domestic production is inadequate to meet domestic requirements. The costs of producing high grade concentrates in this country are so much greater than in other countries that the American consumers rely heavily upon the cheaper foreign material.[10] This is true even though the American producer is protected by a tariff.[11] The major cause for higher costs of United States production is the meager bounty of nature; in other words, the leanness of tungsten content in the ore, as mined.

Salient statistics of tungsten ores and concentrates in the United States, 1940–50, in pounds of contained tungsten [1]

Year	Production	Shipments from mines	Imports for consumption [2]	Consumption	Percent of consumption supplied by domestic production	General imports [3]
1940	4,872,806	5,062,199	5,610,882	9,955,000	48.9	9,666,228
1941	6,420,303	6,249,945	11,522,190	16,699,000	38.4	13,152,716
1942	8,977,575	8,882,463	14,004,257	17,389,000	51.6	15,409,814
1943	11,472,985	11,368,295	19,445,017	19,313,000	59.4	18,678,426
1944	9,764,647	9,786,537	18,396,277	19,165,000	51.0	18,238,890
1945	5,388,639	5,266,818	4,773,861	14,146,000	38.1	8,639,374
1946	4,671,042	4,942,282	6,869,438	6,458,000	72.3	6,811,099
1947	3,026,470	2,944,622	6,018,005	7,812,000	38.7	9,002,115
1948	4,033,389	3,838,287	7,548,101	8,853,000	45.6	9,748,336
1949	2,896,084	2,631,506	6,274,102	4,958,000	58.4	7,357,299
1950 (preliminary) [4]	4,039,000	4,688,000	15,780,000	6,270,000	64.4	8,285,000

[1] From Minerals Yearbooks published by the Department of the Interior.
[2] Comprises ore and concentrates withdrawn from bonded warehouses during year (irrespective of time of importation) and receipts during year for consumption.
[3] Comprises ore and concentrates received in the United States; part went into consumption during the year and the remainder entered bonded warehouses.
[4] Letter from Bureau of Mines to Senator Johnson, dated Apr. 5, 1951.

[10] See appendix B for comparison of prices.
[11] On May 28, 1948, the tariff was reduced under the Geneva Agreement to 38 cents from 50 cents per pound. In December 1950, the tariff returned to 50 cents.

The preceding table indicates the role of domestic production and imports in our supply and consumption picture since 1940.

The following tables show the relationship between domestic consumption and production and various categories of general imports for the war years 1940–44.[12]

	Production	Consumption	Difference	Imports, excluding China [1]	Imports from China [1]	Imports from Bolivia [1]
Year 1940	4,872,806	9,555,000	4,682,194	5,219,764	4,446,464	1,933,245
Year 1941	6,420,303	16,699,000	10,278,697	4,136,197	9,016,519	2,324,172
Year 1942	8,977,575	17,389,000	8,411,425	10,991,314	4,418,500	6,739,934
Year 1943	11,472,985	19,313,000	7,840,015	9,868,848	8,808,578	5,037,184
Year 1944	9,764,647	19,165,000	9,400,353	14,703,926	3,534,964	7,841,821
Total	41,508,316	82,121,000	40,612,684	44,920,049	30,225,025	23,876,356

	Imports from Brazil [1]	Imports from Argentina [1]	Imports from Peru [1]	Total imports from all countries [1]	U. S. Government stockpile
Year 1940	(2)	966,622	386,649	9,666,228	5,417,000
Year 1941	384	443,485	359,273	13,152,716	8,117,000
Year 1942	26,612	2,700,496	222,272	15,409,814	9,532,000
Year 1943	1,135,625	2,093,677	553,868	18,678,426	21,058,000
Year 1944	2,141,350	2,266,856	1,750,219	18,238,890	27,893,000
Total	3,303,971	8,471,136	3,272,281	75,146,074	----------

[1] Comprises general imports of ore and concentrates received in the United States; part went into consumption during the year and the remainder entered bonded warehouses.
[2] Unavailable.
NOTE.—All figures in pounds tungsten.

It is significant that, without Chinese ore, general imports exceeded the deficit between domestic consumption and production only by a small margin, whereas general imports from China about equaled the amount in the Government stockpile at the end of 1944.

The preceding tables also show that imports from South America did not increase substantially until 1942. One can only speculate as to what the United States would have done if Chinese concentrates had not been obtained in the early part of the war.

The United States continued to rely heavily on South American imports in 1945 and 1946, but during 1947, 1948, and 1949 Chinese imports resumed their dominant position. However, in the latter part of 1949 and during 1950 they declined considerably.

On the other hand, total South American production has fallen steadily since 1944, at least until the end of 1950, when prices rose rapidly.

V. World War Experience [13]

A. STOCKPILING ACTIVITIES

The efforts of the United States to improve its tungsten position began with the enactment of the Strategic Materials Act (Public Law No. 117, 76th Cong., ch. 190, 1st sess.) signed by the President on June 7, 1939, which provided for the accumulation of a reserve stockpile. It was evident at that time that domestic production was

[12] 1945 is excluded because the war terminated in that year. Figures obtained from Minerals Yearbooks, published by the Department of the Interior.
[13] No discussion is contained herein regarding the preclusive buying activities of the Government. The purpose of that program was not to acquire tungsten but to keep it away from the enemy.

incapable of satisfying emergency requirements and that reliance could not be placed on receiving adequate imports of tungsten.

Purchases for the stockpile began in 1939 and were made by the Procurement Division of the Treasury Department. In January 1940 the Army-Navy Munitions Board placed tungsten in the "strategic" category. Tungsten was one of nine materials placed on this original list.

Because the methods of purchase prescribed by the Strategic Materials Act were too slow and funds available under the act were inadequate, the procurement of certain strategic materials was transferred to the Reconstruction Finance Corporation. The Metals Reserve Company, a subsidiary of the Reconstruction Finance Corporation, was created on June 28, 1940, to handle this procurement.[14] However, the Procurement Division also continued to purchase these materials for the stockpile.

Logically, both the Procurement Division and the Metals Reserve turned to China with her vast tungsten reserves and large production.

After several independent purchases, the Metals Reserve Company in September 1940 agreed to accept $30,000,000 worth of tungsten in repayment of a loan made to the Republic of China by the Export-Import Bank. Subsequently, in January 1941, another Chinese loan was arranged to be repaid in tunsgten, antimony, and pig tin. Substantial amounts of tungsten were delivered under these arrangements.

However, as a result of the temporary closing of the Burma Road [15] from July 18 to October 17, 1940, available supplies and industry stocks in early 1941 were not sufficient to satisfy the demands of the national defense program. Therefore, in February 1941, President Roosevelt ordered both the Procurement Division of the Treasury Department and the Metals Reserve Company to sell stockpile tungsten to industry.

B. LATIN-AMERICAN PROGRAM [16]

Because of the tightness of the tungsten situation and the unreliability of Chinese deliveries, negotiations were begun early in 1941 for the purchase of Latin-American tungsten.

In May 1941, Metals Reserve Company entered into a contract with Bolivian producers to purchase the entire Bolivian production for 3 years at $21 per short-ton unit.[17] This contract was guaranteed by the Bolivian Government. Similar over-all agreements were made with Peru in October 1941 and with Argentina in November 1941. In May 1941, Metals Reserve Company agreed to purchase all of Brazil's exportable surplus of a number of minerals, including tungsten. A similar agreement was made with Mexico in July 1941.

In addition to these over-all agreements, long-term purchase contracts were made with individual tungsten producers and sellers in these countries, and in Argentina and Bolivia considerable sums of money were expended to bring about an increase in production.

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[14] This was in part occasioned by the need to keep Japan from taking over large stocks of Chinese tungsten awaiting shipment in Indochina in 1940.

[15] When the Burma Road was permanently closed in 1942, tungsten was flown out of China at enormous cost.

[16] In January 1942, the Combined Raw Materials Board was established by Britain and the United States. The responsibility for the Western Hemisphere was assigned to the United States.

[17] Increased to $22.60 in August 1942.

In October 1942, a purchase depot was established at Nogales, Sonora, Mexico, under an agency agreement with the Wah Chang Corp., New York. By November 1943, the construction of a 20-ton concentrator was completed at Nogales to treat low-grade ores before shipment to the United States.

In order to make these Latin-American ores usable, a contract was made with Mr. K. C. Li of the Wah Chang Corp., to handle and treat all tungsten ores received from abroad. Wah Chang Corp. was eventually made sales agent for the Metals Reserve Company.

C. DOMESTIC PROGRAM

In February 1942, the Metals Reserve Company was given the task of stimulating domestic production. Although domestic production had increased substantially since the end of 1940, it was decided that still further increases were necessary to meet wartime requirements.

1. Purchase depots

Special representatives of the Metals Reserve Company weres sent throughout the Western States promoting the production of tungsten. In order that miners could quickly dispose of small lots, purchase depots were established in Arizona, California, Colorado, Nevada, New Mexico, South Dakota. Originally there were 10 depots but they were eventually increased to 20, including 1 in Alaska.

At these depots a miner could deliver his ores or concentrates and receive prompt payment in accordance with price schedules of the Metals Reserve Company.

2. Purchase commitments

In April 1942, the Department of Commerce [18] announced, in part, that Metals Reserve Company would pay $24 per short ton to small producers up to December 31, 1943, provided that these producers would produce at maximum capacity.

As defined in subsequent official circulars, small producers were divided into two categories: (1) "Eligible producers" who produced not less than 600 nor more than 6,000 units of WO_3 in 1941 and (2) "new producers" who produced less than 600 units of WO_3 in 1941. As to "new producers" the Metals Reserve Company was committed to purchase their tungsten until December 31, 1943, but it reserved the right to terminate purchases from "eligible producers" after December 31, 1942, on 30 days' notice. However, if Metals Reserve Company terminated an "eligible producer's" contract before December 31, 1943, it was required to elect (1) to accept at $24 per short-ton unit during each remaining month to December 31, 1943, tonnages not exceeding the average monthly production in the preceding 6 months, or (2) to pay the producer $3 per ton in cash in lieu of accepting deliveries of such tonnage.

Under this program producers whose production exceeded 6,000 units in 1941 could negotiate a similar contract if it could be demonstrated that such a contract was "necessary to stimulate or maintain such producer's production of domestic tungsten."

This purchase program covered high- and low-grade concentrates, ores, middlings, and tailings. Penalties were provided for impurities in the high-grade concentrates and treatment charges were levied

[18] By this date the RFC and its subsidiaries had been transferred to the Department of Commerce.

against the low-grade material.[19] Material as low as 1 percent WO_3 would be accepted in lots of 10 tons; material containing in excess of 3 percent WO_3 would be accepted in lots as small as 1 ton.

Tungsten produced under this program could be delivered to the National Reconditioning Co.,[20] Glen Cove, Long Island, to Metals Reserve Company's chemical plant, Salt Lake City, or to the various purchase depots established by Metals Reserve Company.

In November 1942, the price was increased to $30 per short-ton unit [21] where it remained to the termination of the program. On May 11, 1943, the program was extended to December 31, 1944. Also at this time the production limit to qualify under this program was raised to 13,500 units, applicable to the production of individual properties rather than to the total production of a producer. This program was extended to custom mills and dealers.

3. Salt Lake City chemical treatment plant

In May 1942, the Defense Plant Corporation started the construction of a 100-ton chemical treatment plant at Salt Lake City, Utah. This plant was completed in April 1943 at a cost of approximately $420,000 and was equipped to treat low-grade concentrates not amenable to ordinary milling methods. The construction of this plant provided a market for low-grade material which previously had no outlet in this country, and resulted in a production of over 5 million pounds of usable tungsten.

United States Vanadium Corp. operated this plant as agent for Metals Reserve Company. In addition to purchasing and treating low-grade ores and concentrates, the agent was authorized to make cash advances to producers for the purchase of mining equipment and to carry out field investigations for the location of tungsten deposits.

4. Government controls

Controls began to be placed on the use of tungsten in March 1941 and by the end of 1942 tungsten ores and concentrates, intermediate products, and high-speed steels were subject to rigid allocation and use regulations.

These orders (1) prohibited the use of tungsten in the manufacture of some products, (2) limited the use in other products, (3) required the use of substitutes, particularly molybdenum, and (4) required the approval by the Government of melting schedules for the manufacture of high-speed steels.

5. Financial assistance

Tungsten production was also aided by financial assistance from the Government in the form of (1) advances against production, (2) development loans, and (3) guaranties, or "bail-outs," to producers who invested their own capital under long-term contracts.

In addition, Metals Reserve Company expended funds to have low-grade ore milled, and also operated mines under agency agreements, paying royalties to the owners.

[19] See appendix C.
[20] Subsidiary of Wah Chang Corp.
[21] This resulted in a 2-price system in tungsten. Large producers were subject to a $24 price on their sales to industrial consumers and were not eligible for the $30 price paid to other producers.

6. Termination of programs

The domestic and foreign programs were eminently successful in acquiring tungsten. By the end of 1943, stocks of all kinds were in excess of the consumption in 1943, the peak consumption year,[22] as shown by the following table.

Stocks at end of years 1939–45 [1]

[In pounds of tungsten]

	Consumers and brokers	Producers [2]	Government stockpile [3]	Total
1939	2,667,738	283,803	144,000	3,095,541
1940	2,803,249	93,618	5,417,000	8,313,867
1941	2,404,876	263,626	8,117,000	10,785,502
1942	3,416,438	355,864	9,532,000	13,304,302
1943	2,459,246	458,586	21,058,000	23,975,832
1944	1,510,419	435,634	27,893,000	29,839,053
1945	3,784,429	557,042	[3] 20,603,000	[3] 24,944,471

[1] Data obtained from Minerals Yearbooks published by the Department of the Interior.
[2] Primary concentrates.
[3] Excludes stocks held by the Treasury Procurement Division and U. S. Navy.

Because of the satisfactory situation in the spring and summer of 1944, the Government terminated its foreign and domestic programs. Most of the controls were withdrawn by December 31, 1943. The Salt Lake City chemical retreatment plant was shut down in April 1944.

7. Renewed demand in 1945

Despite the large stocks that had been accumulated, it appeared in the spring of 1945 that there would be insufficient tungsten to fill the requirements of the Army's tungsten carbide shell-core program.[23] This was a new program and it was planned to expend several million dollars in plant and equipment to produce these cores. Because of this new program, some controls were reinstituted, the Salt Lake City plant was reopened, and the foreign purchase program was partially revived.

However, before the program got under way to any substantial extent the European war ended. Resulting cut-backs in the Army's requirements caused the cancellation of the plant-expansion program.

D. APPRAISAL OF WORLD WAR II TUNGSTEN PROGRAM

The Government's World War II tungsten program can best be described as successful but costly. While sufficient supplies of tungsten were obtained, the United States had to pay dearly for them in the form of lost plant investments, high prices, diverted manpower, and manifold governmental regulations. Yet the over-all cost per unit was probably less than double the prewar price for tungsten (based on the 1937–39 average).

The committee has been advised that three sources were mainly responsible for the adequacy of the tungsten supply during World War II. First, more tungsten was received from China than was

[22] Consumption in 1943 was 19,313,000 pounds.
[23] According to Mr. K. C. Li's and Mr. C. Y. Wang's book, Tungsten, this program at one time called for 30,000,000 pounds of tungsten.

expected—30,226,025 pounds from 1940 through 1944. Secondly, the Salt Lake City chemical plant produced over 5,000,000 pounds from April 1943 through 1946, when it was shut down for the second time. Thirdly, the Yellow Pine mine in Idaho, accidentally discovered by engineers of the Bureau of Mines and geologists of the Geological Survey while exploring for antimony, produced about 13,000,000 pounds from 1941 through 1945.

It must be noted, however, that Chinese production is unavailable today; the Salt Lake City plant was disposed of as surplus in 1947 and "all known tungsten ore in the Yellow Pine mine [24] is virtually exhausted." [25]

VI. Present Tungsten Situation

A. Relation between requirements and supply

The United States is once more engaged in an effort to prepare for any eventuality, including all-out war. The preparedness program calls for a great acceleration in our industrial activity requiring a much larger supply of tungsten than was consumed in the years 1946 through 1949.[26]

The Defense Production Administration has advised the committee that "total tungsten requirements are not available" but that "tentative military and stockpile requirements plus overdue deliveries to the stockpile are in excess of total supply." [27] Unofficial estimates place our civilian requirements alone at 14,000,000 to 15,000,000 pounds a year.

The Bureau of Mines estimates domestic production in 1951 at 5,450,000 pounds and general imports at 7,000,000 pounds, resulting in an approximate deficit of 1,500,000 to 2,500,000 pounds for civilian requirements alone. This gives no consideration to the requirements of tungsten for the stockpile or for military purposes, including jet engines and armor-piercing cores. The Defense Production Administration sets the requirements of these items at a figure which also is greater than total expected supply in 1951.

Over a longer emergency period, even these requirements would increase sharply. This is evident from the fact that in World War II tungsten consumption exceeded 19 million pounds per year (1943–44) even though the use of tungsten in jet engines and armor-piercing shells was negligible.[28] The trend toward increased use of jet-engined aircraft is, of course, obvious. Some indication of the magnitude of potential tungsten consumption in armor-piercing cores is given by the fact that a 76 millimeter shell contains a core of sintered tungsten carbide weighing 4 pounds, the bulk of the weight being tungsten.[29]

In view of these increased requirements the adequacy of tungsten supplies is clearly a matter of major importance in any well-conceived preparedness program. In view of the fact that our domestic production has never exceeded 11 million pounds per year and then only because of a fortuitous discovery on the eve of World War II, our

[24] The Yellow Pine mine produced more tungsten than any other mine in the United States between August 1941 and December 1945.
[25] Minerals Yearbook, 1945, published by the Department of the Interior.
[26] In 1949 the United States consumed only 4,958,000 pounds of tungsten.
[27] Letter to Mr. Donald C. Cook, dated February 1, 1951.
[28] Plans were under way for a vast increase in the production of armor-piercing cores early in 1945, but these were shelved after the German surrender.
[29] Li and Wang, Tungsten.

reliance on tungsten imports is unquestionable. Because of our previous reliance on the vast low-cost tungsten resources of the Far East, which are now unavailable,[30] our dependence on other sources of imports has greatly increased. The limitations on such imports become more evident when we recognize that world production outside of Asia and the United States has exceeded 20 million pounds per year only in 2 years (1943–44). Furthermore, it must be remembered that these supplies must be shared with our allies whose dependence on tungsten is probably as great as ours, since most of the industrial countries of Europe have little or no domestic production of tungsten and are equally dependent upon imports. World production outside the United States of America less United States imports indicates that consumption outside the United States approximated 30 million pounds per year during World War II but fell to a level of about 8 million pounds in 1946 when surplus stocks, scrap, and the low level of Western European industrial activity combined to keep consumption low. By 1948 apparent consumption outside of the United States had risen to 23 million pounds. While later figures are not readily available, it is altogether likely that the requirements of our allies in a period of preparedness would closely approximate the total of our own requirements. If it is recognized that our consumption cannot preempt the great bulk of supplies of tungsten in the free world without endangering the military programs of our allies, the problem of tungsten procurement abroad takes on a very somber aspect.

B. STATUS OF NATIONAL STOCKPILE [31]

Faced with the above-described shortage of tungsten, we ask the next logical question, "What have we in our stockpile?"—hopeful that the period from 1946 to the outbreak of the Korean War when tungsten was in suplus was advantageously used to buttress ourselves against a situation of this very kind.

Tungsten is a strategic material in which advance stockpiling is particularly desirable for the following reasons. Firstly, consumption of tungsten rises more sharply in war periods than most basic materials, as indicated above.[32] Furthermore, because tungsten's largest use (except perhaps in military applications) is for cutting tools, which must be produced in advance to make possible increased munitions production, the rise in demand for tungsten during a preparedness or war economy customarily precedes the rise in demand for other materials.[33] Unlike other strategic materials which find large usage directly in consumers durable goods (e. g., copper and zinc) or materials which are indispensable to basic metal production (e. g., manganese and fluorspar), any reduction in production of end items for civilian use does not automatically result in a large saving of tungsten to be diverted to uses peculiar to military requirements. This peculiar significance of tungsten in our preparedness program was apparently overlooked by the Munitions Board and its advisers.

The bitter fact is that our stockpile is pathetically small. True, there is more tungsten in it than there was either at the beginning or

[30] China is Communist-controlled, Burma's production is stagnant because of internal disorders, and Korea is a battlefield.

[31] Up to December 1950, only tungsten concentrates were purchased for the stockpile. In December 1950 ferrotungsten was added to the list.

[32] See p. 2.

[33] Such considerations were widely recognized during World War II and should have been evident to the Munitions Board, which is also charged with planning for machine tools, the ultimate use for a large part of the tungsten.

at the end of World War II, but in relation to our civilian and military requirements we have very little indeed. Not only is the stockpile inadequate in tungsten content, but the forms in which tungsten was stockpiled were not such as to minimize the deficiencies in certain processing and production facilities.

A detailed study of the actions of the Munitions Board in connection with the stockpiling of tungsten reveals a startling degree of shortsightedness and bungling which has hampered our preparedness program and impaired our security. While all of the facts upon which this conclusion is based cannot be made public without direct aid and comfort to our enemies, enough are set forth below to be indicative of the remainder.

1. Inadequate objectives

The main reason for the low state of our tungsten stockpile, in our opinion, is the inadequacy of the stockpile objectives from July 23, 1946, the date of the enactment of the Stockpiling Act,[34] to July 20, 1950, after the beginning of the Korean War.

It was amazing to learn that until December 31, 1948, the Munitions Board kept in effect an objective originally established in July 1944, and amounting to less than 1 year's requirements as currently computed. And it should be emphasized that the objective established in 1944 was rendered obsolete by the Army core[35] program of 1945. Yet that obsolete objective determined the tungsten purchase program until the latter part of 1948.

The fact that the Army required tungsten carbide cores for armor-piercing projectiles was no secret. It was discussed in the Interior Department's Minerals Yearbook, 1945,[36] Mr. K. C. Li's and Mr. C. Y. Wang's book entitled "Tungsten"[37] and other published material.[38] It passes all comprehension why the stockpile objective contained no provision for armor-piercing cores until the latter part of 1948. The responsibility for this dangerous omission must be borne jointly by the Department of the Army and the Munitions Board. Although the Army advised the Munitions Board, several times from 1946 to 1948, that it used tungsten armor-piercing cores, neither agency took any action to assure the inclusion of the required amount of tungsten for cores in the stockpile objective.

In any event, on December 8, 1948, the Munitions Board advised the Assistant Secretary of the Army that the Strategic Materials Committee was "appalled" by the size of the newly learned Army requirements. Yet, astounding as this may seem, the first two purchase directives issued after this discovery bore the notation, "Purchase is not urgent." The Secretary of the Interior criticized these directives as "being inadequate" but nothing significant was done to improve the situation until the fall of 1949.

The initial objective was increased on December 31, 1948, but even this new objective was inadequate in that it failed to recognize the

[34] The Strategic and Critical Materials Stockpiling Act (referred to in the report as the "Stockpiling Act") provided for the "acquisition and retention of stocks * * * to * * * prevent whenever possible a dangerous and costly dependence of the United States upon foreign nations for supplies of these materials in times of national emergency." In the administration of this act the Munitions Board and the Secretary of the Interior were jointly responsible for deciding how much of each item should be accumulated. These amounts are called stockpile objectives and, if acquired, are supposed to prevent a dangerous and costly dependence upon foreign nations in times of national emergency.

[35] This core program requires by far more tungsten than any other military use.

[36] P. 661.

[37] P. 347 (published in 1947).

[38] As a matter of fact, in April 1948, Mr. K. C. Li, Wah Chang Corp., wrote to the Army suggesting that tungsten carbide be stockpiled because of the large amounts needed for the core program. This suggestion was referred to the Munitions Board.

need to discount the probability that some imports would be cut off during a war. It is obvious that such an inadequate objective would not protect this country from "a dangerous and costly dependence * * * upon foreign nations * * * in times of national emergency," as contemplated in the stockpiling statute. This second inadequate objective was maintained for over a year and a half because of a disagreement between the Department of Interior and the Munitions Board over strategic assumptions which are the basis for discounting imports.

The first realistic objective was established on July 20, 1950, after the Korean War had started.[39] The objective, established on July 20, 1950, was raised further on November 30, 1950, and the committee has been informed that it may be increased further.

Of course inadequate objectives resulted in inadequate procurement of tungsten for the stockpile.

2. Inadequate procurement

(*a*) *Quantitative.*—Obviously, so long as the stockpile objective was set low (because of an incomprehensible oversight regarding the core program), tungsten procurement was not considered urgent. Between the termination of World War II and the middle of 1948, the stockpile merely acquired tungsten ores and concentrates accumulated by other Government agencies during World War II. These transfers, of course did not increase stocks of the metal in the hands of the Government.

Based on the low objective the Munitions Board reported to the Congress that as of June 30, 1948, the percentage fulfillment was about 85 percent at that time the objectives of only 5 other materials of the 77 then listed for stockpiling were closer to complete fulfillment than tungsten.

The first purchase directive (as contrasted to transfers from other Government agencies) was not issued until August 1948, closely coinciding with the date when the Munitions Board apparently was first informed concerning the Army's core program and the related requirement for tungsten. This directive as indicated above, bore the notation, "purchase is not urgent and is to be made only at $——[40] per unit or below." By December 1948, the price limit was lifted and the quantity increased, but actual deliveries were relatively small until well into 1950. For example, deliveries under purchase contracts to June 30, 1949, were less than 10 percent of the quantity, which should have been delivered based on estimate presented to the Congress in January 1949. By the end of 1949 deliveries were only about one-third of the January 1949 estimate for that date even though the July 1949 report to the Congress estimated a further increase in the quantity to be delivered.

Even these small additions to the stockpile were partly due to the fact that the domestic tungsten industry was in distress in 1949. Apparently reacting to requests by the domestic producers, the Munitions Board in August 1949 issued directives to increase purchases and urged the procurement authorities to make tungsten purchases in such fashion as to keep as many producers as possible in operation. Purchase commitments were thereafter increased but even these actions were not wholehearted, as will be demonstrated below in connection with specifications for purchase.

[39] This lapse of more than a year, at a time when political control of our largest import source, China, was falling into hands of a hostile government, vividly illustrates the inertia and lack of intelligence which characterized the tungsten stockpiling program.

[40] Amount is confidential.

It should be noted that total purchase commitments by the end of 1949, with deliveries scheduled into 1951, when added to existing inventories would still have yielded only about half of the then total stockpile objective. And this objective was later substantially increased.

(*b*) *Specifications.*—Experience shows that, when the United States needs tungsten, in large quantities, it has always been necessary to utilize lower grade and less pure ores.

During World War II the Metals Reserve Company established basic specifications [41] for tungsten concentrates but provided for the acquisition, on a penalty basis, of tungsten containing a greater percentage of impurities than provided for in the specifications. Foreign procurement contracts contained the same type of provision. The recently announced domestic floor price program of the Defense Minerals Administration has again resorted to this device to bring forth large quantities of tungsten.[42]

The Munitions Board adopted its specifications in January 1945 after obtaining advice from tungsten consumers. These specifications generally parallel those set by the Metals Reserve Company, but do not provide for the purchase of concentrates not meeting these standards under a penalty system.

The Munitions Board in fixing its specifications was guided by the principle of universal application of the material to all essential end uses. In other words, the Munitions Board desired the material in the stockpile to be available for high-speed steels, carbides, electronics, armor-piercing cores, and other uses.

This principle would be fine in theory if adequate amounts of material meeting specifications were available. But the sources of tungsten meeting these specifications without retreatment are limited and this fact should have been known to the Munitions Board. Tungsten produced in South America and the Iberian Peninsula is known to be generally below stockpile specifications. The General Services Administration even had to arrange for the beneficiation of some of the material received under their Chinese contract.

The Munitions Board obviously established these specifications without relating them in any way to the large amounts needed for the stockpile. They were set in 1945 before the Army core program was established and were maintained in their original form, with the exception of one minor change, until January 1951,[43] despite very sizable increases in the stockpile objective.

This committee believes that the stockpile specifications should have been set with detailed consideration of the ability to acquire material meeting those specifications. There is no evidence of any serious consideration or study having been devoted to this problem.

The Board's insistence on the highest grade material was sound until the fall of 1948, so long as the objective was low and the amount in the stockpile was about 85 percent of the objective.[44] However, when the objective was raised in 1948, it should have been obvious, based on World War II statistics alone, that an intensified procurement program would be necessary to attain the objective. Therefore, it should have been apparent that specifications would have to be

[41] See appendix C.
[42] See appendix F.
[43] See appendix D.
[44] As indicated above, the committee feels the objective was set too low. So long as the objective was low and the unfilled balance small, the specifications question seemed to be of minor importance. But when the objective was increased the problem of specifications became acute.

liberalized to include purchases of lower grade and less pure material, at appropriate discounts reflecting possible future retreatment costs.

Certainly, this should have been realized in the fall of 1949 when imports of Chinese ores diminished and China began to be dominated by the Communists. A comparison of their objective with the amounts available during World War II from the countries comprising the now free world would have revealed to the Munitions Board that they had a tremendous and difficult task to perform. That task, comparable again to that of World War II, clearly required a similar liberalization in specifications. The two subsequent increases in stockpile objectives, of course, only increased the need for a more realistic policy.

Apparently oblivious to the significance for stockpiling of over-rigid specifications, the Munitions Board made no real effort to determine what quality of tungsten the various segments of industry could use and it ignored industry's ability to beneficiate low-grade and impure concentrates and to mix the same with high-grade ores.

We have received several complaints from representatives of domestic producers indicating that the stockpile specifications were too rigid, particularly with regard to the permissible molybdenum [45] content and that, with the exception of a few, domestic producers were required to have their product chemically treated by an expensive process in order to meet these specifications. The small producers, not being able to afford the treatment charge, were thus eliminated from the stockpile market.

The following two transactions illustrate the operation of these specifications.

In October 1948 [46] the Climax-Molybdenum Co. offered to the Government its entire production of tungsten for the period from November 1948 to December 1949. This offer was rejected because the phosphorous content ranged between 0.05 and 0.15 percent. Climax mixed these concentrates with purer concentrates and ferrotungsten for industry was made from them.

In August 1950, Consolidated Tungsten Mine offered three lots of tungsten concentrates to the General Services Administration. The company's assay showed molybdenum content to be 0.38 percent as against permissible content of 0.4 percent. General Services Administration's analysis showed 0.47 percent. The umpire's analysis showed 0.46 percent. The tungsten was rejected [47] by the General Services Administration and later this tungsten was sold to the Wah Chang Corp. at a higher price.

Mr. H. A. Savage, president, American Tungsten Association, contends that the rigid molybdenum specification is unrealistic in view of the fact that many high-speed steels require the reintroduction of molybdenum into the end product.[48]

[45] Principal impurity of domestic ores.

[46] This was subsequent to the date the Munitions Board was first advised of the enormous requirements of the Army.

[47] On January 16, 1951, the Munitions Board, authorizing the General Services Administration to purchase material not meeting stockpile specifications, particularly referred to the "number of occasions on which tungsten ores were offered for stockpile purchase and were turned down because they did not meet minimum stockpile specifications."

[48] This view is shared by others in the industry. The principal substitute for tungsten high-speed steels is molybdenum-tungsten high-speed steels.

In answer to an inquiry concerning the rigidity of these specifications, the Bureau of Mines said,[49] in part:

> From the standpoint of domestic producers in most of the Western States, the specification regarding molybdenum content is considered to be out of line for tungsten that will be used in steel, as in many cases molybdenum [50] is added to the same steel batch that calls for tungsten. Because of the nature of the ores mined, many producers have not been able to meet this specification. On the other hand it is possible that the specifications for tungsten for use as carbide may be too rigid with respect to some elements that are objectionable only in steel. This has not affected domestic producers to any extent, but would apply particularly to some South American ores.

If the Munitions Board had been more interested in finding out what quality of tungsten industry could and would use in a period of high demand rather than what the consumers desired during a period of oversupply, more tungsten would now be in the stockpile.

Furthermore, in adhering strictly to its rigid specifications, the Munitions Board failed to take account as a factor in its procurement of tungsten, the ability of industry to beneficiate low-grade ores to stockpile specifications. Mr. K. C. Li, Wah Chang Corp., stated in a letter, dated September 8, 1944, to the Munitions Board that "processing has progressed so far that any ore can be processed to procurement specifications." During World War II, the Government had low-grade ores upgraded both at the Government-constructed chemical treatment plant at Salt Lake City and by the Wah Chang Corp.

In addition, the Board also ignored the practice of blending low-grade and high-grade ores to obtain a satisfactory mixture. With probably the largest inventory of tungsten in the world, the stockpile authorities could have done a lot of blending.

Whenever stockpiling impure ores is suggested, the stock reply is that it would require "earmarking" the material. This would be a small price to pay for preparedness in tungsten. Furthermore, and in any event, the Molybdenum Corp., of America on July 28, 1948, recommended that "a complete detailed report [be] made available of every lot." [51]

Lest there be any misunderstanding, we are here making no attempt to determine what prices should have been paid for lower grade and less pure ores, but merely indicating that the ores, which were usable either by blending with other ores or amenable to chemical treatment should have been acquired, for the stockpile at a price reflecting a discount for such impurities. The experience and know-how of Government and industry could have been and should have been applied to the procurement problem tying together the stockpile objectives, the availability of ores, and the varied techniques for treating or using these ores.

It seems clear that the Munitions Board overlooked its main purpose—to acquire adequate amounts of usable tungsten—and overemphasized the quality of the metal to be acquired.

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[49] Letter dated February 6, 1951, to Senator Johnson.

[50] In an article in the May 1951 issue of the Engineering and Mining Journal (p. 76), three officials of the United States Vanadium Co. said: "Also the high-grade table concentrate always carried 2.5 to 3 percent molybdenum. Only a chemical treatment can remove this element, but for certain alloys, the molybdenum content is not objectionable. Therefore, most of the tungsten flotation concentrate goes to the chemical plant for purification, but some of the table concentrate is shipped for use in making tungsten-molybdenum alloys."

[51] Letter to Capt. H. C. Maull, Jr., Treasury Department, Procurement Division.

Finally, on January 16, 1951, the Munitions Board expanded—

> the stockpile purchase program to include materials of lower grades and cruder forms than covered by stockpile purchase specifications * * * where the necessary further processing can be accomplished in the United States.

This should have been the policy since the time when the Munitions Board first became aware of the Army's requirements. The Board should have realized that the adage, "beggars cannot be choosers," applies to the United States as far as tungsten is concerned.

3. Stockpiling intermediate products

Before reaching final form, the vast majority of tungsten concentrates is either (1) converted into ferrotungsten from which high-speed steels are made, (2) charged directly to the steel bath to make high-speed steels, or (3) processed into tungsten metal powder used to make tungsten carbide, tungsten sheet, wire and rod, electronic products, alloys used in jet engines and cores for high velocity armor-piercing projectiles.

The following tables show the relative amounts used in these processes:

Production of specific tungsten products in the United States in pounds [1]

	1943		1944		1945		1946	
	Gross weight	Tungsten content	Gross weight	Tungsten content	Gross weight	Tungsten content	Gross weight	Tungsten content
Ferrotungsten	[2] 13,876,000	[2] 10,891,593	13,391,658	10,264,824	8,214,504	6,545,277	2,699,926	2,089,608
Tungsten metal powder	2,741,099	2,739,036	4,123,867	4,117,586	4,909,061	4,900,177	1,368,195	1,364,264
Special tungsten alloys	[3]	[3]	317,648	196,277	409,040	253,200	434,619	179,030
Sodium tungstate [4]	[3]	[3]	573,721	321,280	421,704	236,085	791,255	440,841
Tungstic oxide [4]	[3]	[3]	492,966	390,233	599,828	474,092	273,470	216,037
Tungstic acid and ammonium paratungstate	[3]	[3]	625,911	452,998	689,889	497,460	211,047	149,143

[1] Minerals Yearbook, 1944, 1946 published by the Department of the Interior. Detailed data later than 1946 are not available.
[2] Excludes ferrotungsten produced under conversion agreement for a foreign consumer from consumers' own concentrates.
[3] Figures not available
[4] Figures cover production for sale only and therefore exclude production as an intermediate product of producers. Probably the greater part of the production reported for tungstic acid, tungsten oxide, and ammonium paratungstate is used in making tungsten powder.

Percent consumption of tungsten concentrates in the United States from 1942 through 1949 [1]

	1942	1943	1944	1945	1946	1947	1948	1949
Ferrotungsten	68	61	59	50	35	46	44	47
Steel bath	17	14	13	13	28	17	20	16
Tungsten metal powder and other products	15	25	28	37	37	37	36	37
Total	100	100	100	100	100	100	100	100

[1] Minerals Yearbooks 1942-49 published by the Department of the Interior.

In the process of converting tungsten ores or concentrates to metal powder, a number of chemical operations are undertaken and as indicated above, some of these intermediate chemical products are used, as such, in relatively small amounts.

Tungsten carbide (used in cutting tools) is produced from tungsten powder.

In view of the large potential requirements for tungsten (in various forms), interest in the adequacy of the facilities in the United States for producing ferrotungsten and metal powder should have been evinced by the Munitions Board. Of course, so long as future requirements were estimated as not greatly different from peak World War II requirements, both in total and in kind, facilities for production of ferrotungsten, tungsten powder, and tungsten carbide were probably adequate at least so long as capacity in existence during the peak period was still available in good working order.

However, when estimated annual requirements for a future emergency were increased substantially above World War II levels,[52] particularly for tungsten powder and tungsten carbide, it is reasonable to assume that the Munitions Board would have inquired into the productive capacity and facilities for the manufacture of these products. Let us, however, look at the record concerning studies of the adequacy of facilities and the related question of stockpiling of intermediate products.

(*a*) *Ferrotungsten.*—As early as January 1945 the Molybdenum Corp. of America, having one of only two ferrotungsten refining plants in this country, recommended that the stockpile be divided into (1) very high grade ores for direct smelting, lamps, radio work, etc., and (2) lower grade ores to be turned into ferrotungsten.[53] In support of this recommendation it was stated that—

> The bottleneck in the situation is refining. There are only two refining plants today equipped to turn out ferrotungsten. If one or both of these plants should be sabotaged the whole high-speed steel industry would come to a stop until refining plants could be rebuilt, a long process on account of the electrical equipment necessary.

In July 1948 and again in April 1949 the Molybdenum Corp. repeated its previous recommendation that ferrotungsten be stockpiled and, in addition, recommended the stockpiling of tungsten metal powder pointing out that "there are only a few plants equipped to make it satisfactorily." [54]

[52] This was done for the first time late in 1948, and thereafter again in 1950.
[53] Letter dated January 11, 1945, to Maj. Carl Rolle from Mr. Van Ransselaer Lansingh, vice president.
[54] In the July 1948 letter, it was suggested that the stockpile be divided equally between concentrates, ferrotungsten, and metal powder. In the following letter the Molybdenum Corp. recommended that 30 percent of the stockpile be in the form of concentrates, 45 percent ferrotungsten, and 25 percent metal powder

(*b*) *Tungsten carbide or metal powder.*—Tungsten carbide customarily is made directly from tungsten metal powder. The stockpiling of either product would protect this country from any inadequacy in our powder-producing facilities. Armor-piercing cores, the largest military use of tungsten, are made from tungsten carbide.

Besides the two recommendations by the Molybdenum Corp. discussed above, there were numerous other recommendations made to the Munitions Board that either tungsten carbide or metal powder be stockpiled. Mr. K. C. Li of the Wah Chang Corp. was the most persistent advocate. Between April 1948 and August 1950 he wrote no less than six letters to various high-ranking officials in the Department of the Army, the Munitions Board, and the National Security Council recommending the stockpiling of tungsten carbide and other intermediate products. All of these letters were referred to the Munitions Board.[55]

Mr. Li pointed out that in 1945 plans were made to expend large sums of money for the construction of a plant to produce tungsten carbide for the Army core program. This expenditure was necessary because the existing facilities were grossly inadequate to meet the Army requirements. He asserted that these facilities were still inadequate and that the stockpiling of tungsten ore did not provide adequate protection against this inadequacy. He contended that diversification of our stockpile was necessary and recommended that either the Army or the Munitions Board stockpile tungsten carbide and other semifinished products.

As a result of Mr. Li's letters the Army's Procurement Division in May 1948 recommended to the Assistant Secretary that the Ordnance Department be authorized to establish a reserve stockpile of tungsten carbide. This recommendation was referred to Ordnance for further study.

In August 1950, over 2 years later, Ordnance recommended to the Logistics Division that tungsten carbide be stockpiled and the Logistics Division through the Under Secretary made the same recommendation to the Munitions Board.

The Munitions Board replied in October 1950 that it would make a study of both metal and carbide, which study would involve many aspects of the over-all tungsten situation.

(*c*) *Action taken by Munitions Boards.*—On August 20, 1948, the Munitions Board redefined strategic and critical materials to include semiprocessed material where "an insufficiency of processing capacity might cause a dangerous and costly dependence" or otherwise offer so hazardous a risk to national security as to justify the stockpiling of processed materials.[56] Under this policy, aluminum metal was approved for inclusion among the materials to be stockpiled.

But the first affirmative attempt by the Munitions Board to determine the adequacy of the tungsten processing facilities was in January 1950, when the Chairman directed that studies be made of certain commodities, including tungsten—

> to ascertain whether, owing to limited plant facilities, the material should be stockpiled in an advanced form.[57]

That study was completed on October 5, 1950, about 10 months later, and concluded with a recommendation that a substantial quan-

[55] These letters are discussed in greater detail in the next section of this report.
[56] Stockpile Report to the Congress January 23, 1950.
[57] Letter to Senator Johnson dated January 6, 1951.

tity of tungsten metal powder be stockpiled. However, because this study showed that there was—

> insufficient information in any Government agency to properly evaluate the facilities for the production of tungsten metal powder, carbide and other tungsten products[57]—

it was decided that this information should be first obtained from industry by questionnaires.

These questionnaires were finally sent out in December by the Bureau of Mines but, even though the Munitions Board stated that the data would be available by February 15, 1951, it was not until June 1 that the committee was informed that the study had been completed. It is probably this survey to which the Munitions Board referred when it advised the Under Secretary of the Army that it would make a study involving many aspects of the over-all tungsten situation.

Because of the importance of adequate tungsten processing facilities, we sought information from the various interested agencies on the subject.

The Bureau of Mines advised[58] us that—

> it is probable that facilities for the production of metallic tungsten and tungsten carbide will not be adequate to meet the demands of the defense program.

By a letter of January 13 to Mr. Donald C. Cook, chief counsel, the General Services Administration stated that the ferrotungsten—

> facilities are not believed to be adequate to handle the anticipated increase in requirements—

but in a later letter to the chief counsel, dated March 12, the General Services Administration reversed its previous opinion as to the inadequacy of ferrotungsten processing facilities and expressed doubt about the adequacy of the metal powder facilities. Furthermore, the General Services Administration recommended the stockpiling of metal powder.

The Munitions Board advised[59] us that ample facilities exist for the production of ferrotungsten; however, we were advised by Mr. Marx Hirsch,[60] president of the Molybdenum Corp. of America that, in his opinion, ferrotungsten facilities would need expansion in the event of an all-out war.

It is impossible to understand how the recommendations of industrial concerns and the Department of the Army could have been intelligently considered without knowledge as to the capacity of the facilities involved. It would appear that an inquiry would have been undertaken immediately after similar recommendations were made by two leading tungsten-processing organizations.[61]

The above-described survey reveals, among other things, a substantial potential shortage of tungsten-powder facilities, even after taking account of presently planned additions. This shortage results from the requirements for tungsten carbide, at present produced solely from metal powder. Unless there are clear indications, as a result of detailed tests, that tungsten carbide can be produced without initially producing metal powder, it is obvious that a shortage of metal-powder

[57] Letter to Senator Johnson dated January 6, 1951.
[58] Letter to Senator Johnson dated February 6, 1951.
[59] Letter to Senator Johnson dated January 26, 1951.
[60] Mr. Hirsch is president of one of the two ferrotungsten manufacturing companies in the United States.
[61] The Molybdenum Corp. of America and the Wah Chang Corp.

facilities may prove a major bottleneck in the production of tungsten carbide and artillery cores.[62]

In the case of ferrotungsten, where there is apparently still some difference of opinion as to the adequacy of capacity for future requirements,[63] the Board authorized purchases for stockpiling in December 1950. In the case of powder and carbide, where a shortage of facilities is more clearly indicated, no steps have as yet been taken in this regard.

We are particularly disturbed by the Munition Board's failure to recognize the advisability of stockpiling either tungsten carbide or metal powder. When the Munitions Board first was advised in 1948 of the enormous amount of tungsten required for cores, it should have promptly considered the problem of processing capacity. The experience of World War II was recent and well-known and there appears to be no valid excuse for not having embarked on the necessary studies immediately.[64]

This failure is all the more inexplicable since the Army and Navy Munitions Board (predecessor of Munitions Board) prepared a document dated June 1, 1948, entitled "Guide for Joint Industry—Military Procurement Planning," [65] which pointed out that both ferrotungsten and tungsten carbide facilities were inadequate during World War II. The purpose of this document was to acquaint industry with what it might be called upon to do in the event of another war.

Apparently the Board did not recognize the implications of its own document in connection with its stockpiling duties and responsibilities.

C. A NEW PROCESS FOR MAKING TUNGSTEN CARBIDE

Between the termination of World War II and the spring of 1948, Mr. K. C. Li, chairman of the Wah Chang Corp., developed a new process for making tungsten carbide which he thought would be of considerable value to the United States. By this process, carbide could be made directly from low grade and impure tungsten ores whereas the conventional method required that the ores be made first into sodium tungstate, then into tungstic acid, next into tungsten metal powder, and finally into tungsten carbide.

Mr. Li felt that this was a valuable discovery because (1) it reduced the time required to turn tungsten ores into cores; (2) it reduced the waste of tungsten by 20 or 25 percent; and (3) it would substantially reduce the cost of the construction of the necessary plant and equipment to produce tungsten cores.

Mr. Li presented his new discovery to the Assistant Secretary of the Army at a meeting in the early part of 1948, and, apparently, in accordance with a suggestion formally submitted it on April 29, 1948, for consideration by a letter to the Assistant Secretary.

Mr. Li pointed out in that letter that his organization undertook the research leading up to his new process because he was told that

[62] See following section.

[63] This is partly dependent on the extent to which ores suitable for direct charge to the steel bath are likely to be available.

[64] It should be noted that this criticism is directed against a failure by the Board to inform itself adequately on the nature and extent of the problem. Whether the Board should have made purchases of ferrotungsten and tungsten powder in the period is more controversial, since its funds and contract authority were limited. It is, however, reasonable to suppose that if a shortage of processing capacity had been established promptly, that the total requirements of funds for stockpiling would have been increased and would have led to requests for larger appropriations, certainly a responsibility of the Munitions Board.

[65] Exhibit 69, Hearings Before the Subcommittee on Mines and Mining of the Committee on the Public Lands, House of Representatives, 80th Cong., 2d sess., pts. 4 and 5, May 3 and 6, 1948.

the armies of Field Marshal Von Runstedt were stopped during the Battle of the Bulge (in Belgium) because of the effectiveness of the antitank tungsten core shells. He said that he thought that it was his duty to inform the Army of his discovery and would follow the advice of the Army as to whether it should be patented. He was afraid that if it were patented by the usual method the new process would be revealed to the world.

Pointing out that the United States had planned to spend several hundred million dollars in 1945 to manufacture carbide for the core program, and that the present facilities were inadequate, Mr. Li suggested that the Army stockpile carbide produced from a plant he was planning to build to manufacture this material by his new process.

This matter was turned over to the Army's Procurement Division, which advised the Assistant Secretary on May 28, 1948, that the Munitions Board would not stockpile tungsten carbide because it considered carbide to be only critical, not both strategic and critical. The Procurement Division, however, recommended that the Ordnance Department be authorized to establish a reserve stockpile of tungsten carbide.

The matter was then referred to the Ordnance Department for further study and Ordnance in turn referred it to the Watertown Arsenal.

Samples of Mr. Li's carbide were sent to the arsenal in September 1948, and on June 20, 1949, a summary report was submitted to the Ordnance Department. This report was sent to the Research and Development Division, which on July 7, 1949, sent it to the Industrial Division in order that further studies could be made. Thus at the end of a year and a half the only conclusion reached was that further studies were necessary.

By February 1950, some 8 months later, Mr. Li was getting impatient. On February 20 he wrote Mr. Carl Rolle of the Munitions Board, and on February 23 he wrote both the Secretary of the Army and Gen. Garson K. Heiss, who participated in the original conference in the early part of 1948 some 2 years earlier.

In these letters Mr. Li again recommended that tungsten carbide be stockpiled as well as other semifinished products because this country had no adequate protection against our lack of production facilities. He pointed out that diversification of the stockpile was essential.

He further stated that he had not yet received the final report on the tests of his carbide. He received replies that the tests were being studied and the feasibility of processing new materials to an advanced state was being discussed. Thus after 2 years the matter was still in the study and discussion stage. One cannot but wonder what these individuals would have done if confronted by an immediate army on a battlefield.

In March the Ordnance Department decided that scale model projectile cores could be satisfactorily made from Mr. Li's carbide. However, the matter was then further passed around the Ordnance Department, the Logistics Division and the Munitions Board until Mr. Li again became impatient. And who wouldn't?

On August 3, 1950, Mr. Li wrote Mr. John R. Steelman,[66] the Assistant to the President. In this letter he surveyed the deterioration

[66] On August 2, 1950, he also wrote the Secretary of the Army.

of the world-wide tungsten situation, particularly pointing out the unavailability of the vast resources of the Far East. He recommended that—

> the Government * * * give prompt consideration to the immediate manufacture of tungsten carbide crystals and other semifinished products by the new method recently developed by us.

He repeated that he had not yet received a report on the tests made by the Watertown Arsenal and again offered his services in the design or construction and operation of a plant for the production of semifinished products. He advised Mr. Steelman that he had already purchased a suitable site in the South for such a plant. Despite a brief and unresponsive reply from Mr. Howard, then chairman of the Munitions Board, to whom all the correspondence had been referred, the Department of the Army's interest in the process was apparently renewed.

On November 1, Ordnance asked Mr. Li for additional samples of his carbide so that tests on full-size cores could be made. It appears that, after 2½ years of study, the samples used in the original tests were too small for any conclusive result. These additional samples were submitted to the Watertown Arsenal on December 4. Finally, on February 9, 1951, almost 3 years after Mr. Li submitted his new discovery to the Army, firing tests were made of cores made from his tungsten carbide. In an age when a war could be won or lost in weeks or months the Army took 3 years to make even a preliminary evaluation of a process which could possibly have spelled the difference between success or failure in achieving security in tungsten.

The present conclusion of the Army is that although satisfactory cores can be made, the milling time required to render Mr. Li's carbide suitable for core manufacture makes it economically undesirable. It seems that Mr. Li's tungsten carbide powder, as produced, is coarser than the standard material, and it has to be milled to finer particles before being made into cores. This apparently is not necessary with the standard tungsten carbide powder.

We believe that the severest criticism of the Department of the Army is warranted for the dilatory and cavalier manner in which this proposal was handled. It is impossible for the committee to believe that the Department of the Army was unaware of the potential importance of the discovery, yet action was obviously too little and too late.

It should be clearly understood, however, that we are not endeavoring to judge the merits of Mr. Li's new process. But we believe that the time consumed by the Army before reaching a conclusion was clearly and inexcusably excessive.

Nor are we satisfied with the conclusion that the milling time required to produce carbide suitable for core manufacture under Mr. Li's process makes it "economically undesirable." Accordingly, we have asked the Army for an explanation of what it means by the term "economically undesirable." We believe that any appropriate comparison of Mr. Li's process with the conventional process would have to weigh the advantages and disadvantages of each process from ore to core, in terms of time, material, and money. In view of the fact that adequate stockpiles of tungsten ores have not been built up, great weight should be given to the tungsten conservation aspects claimed for the Li process, if they can be substantiated.[66a]

[66a] After this report was prepared the committee was informed that the Department of the Army has taken steps to assist Mr. Li in further developing his process.

It is ironic that one of the factors which influenced the Munitions Board not to stockpile metal powder was the potentialities of Mr. Li's process. To base a decision not to stockpile a critical item on an untested proposal, whatever the final results of the tests, is folly. Certainly, the Munitions Board had no sound basis for concluding either that Mr. Li's product would be satisfactory or that it would be determined to be satisfactory in time to permit the construction of the necessary facilities.

In any event, the committee is firmly of the opinion that the actions of the various Government agencies with respect to tungsten, in its various forms, should have been harmonized. A final determination should be made promptly as to the value of the Li process. A decision with respect to erection of new facilities for powder or carbide production or both should be made promptly, based on evaluations of competing processes. Nothing can be more detrimental, in this area of munitions procurement, than a continuation of the policy of inaction, based on the fear of new technological developments. The Department of Defense should reconcile the conflicting views and policies followed by the Department of the Army and the Munitions Board, promptly.

D. POST-KOREAN PROBLEMS

At the time of the outbreak of the Korean War, the Nation's production and imports of tungsten was approximating 13 million pounds per year. During the second half of 1950, because of a drop in general imports, our rate of production and imports decreased while consumption rose sharply, reducing the margin going into inventories. In 1951, as the following table indicates, there appears to be little scope for stockpiling. In fact, we will be fortunate to acquire sufficient tungsten for current consumption requirements.

Tungsten supply and requirements

[In thousands of pounds]

	January–June 1950, annual rate	July–December 1950, annual rate	1951 estimate
Production	3,806	4,272	5,450
General imports	9,080	7,490	7,000
Supply	12,886	11,762	12,450
Consumption	4,229	8,312	[1] 14–15,000
Surplus	[2] 8,657	[3] 3,450	[4] 1,550–2,550

[1] The estimate for 1951 consumption does not include requirements for artillery cores, jet engines, or atomic energy.
[2] Includes imports from China and Korea of 4,940,000 pounds.
[3] Includes imports from China and Korea of 405,000 pounds.
[4] Deficit.

The tungsten-supply situation is much more serious than it was in the beginning of World War II. At that time the supply of the countries presently forming the free world had to be divided, as a practical matter, only between Great Britain and the United States. At the present time this supply must be shared by all the nations of the free world, which includes the substantial consumption of Western Europe.

When the world's production, exclusive of Asia and the U. S. S. R., of about 14,000,000 pounds in 1949[67] is compared with the 1951 requirements of the United States alone, the task facing this country and other nations in the free world becomes clear. Once the preparedness program was decided upon, the need for prompt and aggressive action to meet the increased requirements was clear. On the one hand, it would be necessary to conserve whatever supplies of tungsten were or would be available by limiting its use to most essential requirements. On the other hand, aggressive action would be required to stimulate production, both at home and abroad. Production from operating mines would have to be increased and old mines reopened.

1. Legislative authority

Recognizing, among other things, the need of the executive branch for special powers to meet this situation for a wide range of materials, including tungsten, Congress passed the Defense Production Act.[68]

This act granted the President price, wage, allocation, priority, and requisition powers. It also authorized the President to (1) guarantee private loans, (2) make direct Government loans,[69] and (3) enter into procurement contracts and commitments to expand the productive capacity and supply of materials and services, including metals and minerals, needed in the defense program.

This act authorized the agencies to which these powers were to be delegated to borrow $600,000,000 from the Treasury to carry out the functions of this act.

2. Delegations of authority

At the outset, by Executive Order 10161, dated September 9, 1950, the Secretary of the Interior was delegated the authority to determine what loans and procurement contracts and other commitments should be made with respect to metals and minerals. Under this order, the Reconstruction Finance Corporation was required to make such loans and the General Services Administration was required to enter into such purchase contracts and commitments as the Secretary certified as necessary.

The Secretary was also directed "to encourage the exploration, development, and mining of critical and strategic minerals and metals." To carry out these functions, the Secretary created the Defense Minerals Administration.

By virtue of subsequent orders and delegations,[70] the authority to certify the loans to be made by the Reconstruction Finance Corporation and the purchase contracts and commitments to be entered into by the General Services Administration was transferred from the Secretary of the Interior to the Defense Production Administration,[71] based on recommendations of the Defense Minerals Administration.

The Defense Minerals Administration was given allocation, priority, and requisition control generally over ores and concentrates.

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[67] About half of the world's production in 1949 originated in Asia and the U. S. S. R.

[68] Public Law 774, 81st Cong. (64 Stat. 798), approved Sept. 8, 1950.

[69] This type of financial assistance can be extended only to the extent that it is not otherwise available on reasonable terms.

[70] Executive Order 10161, September 9, 1951; Interior Department Order No. 2605, December 4, 1950; National Production Authority Delegation 5, December 18, 1950; Executive Order 10200, January 3, 1951; Defense Production Administration Delegation 1, January 24, 1951; Interior Department Order No. 2605, amendment 2, March 6, 1951.

[71] A newly created agency.

3. Action taken pursuant to delegations of power

This committee has made an effort to appraise the results of the defense agencies to better this country's tungsten position. This appraisal has considered the efforts (1) to conserve tungsten supplies, (2) to increase domestic production, and (3) to increase imports.

(*a*) *Conservation of tungsten supplies.*—The first step taken by any Government agency under the Defense Production Act was on September 18, 1950,[72] when the National Production Authority limited the amount of tungsten semifinished products and scrap that could be accumulated to not "more than a practicable working inventory." On October 3, 1950,[73] a priorities system was established including tungsten and tungsten products and on December 27, 1950, the National Production Authority designated many items including tungsten semifinished products as "scarce materials" within the meaning of section 102 of the Defense Production Act. This section forbids the accumulation (1) in excess of the reasonable demands of business, personal, or home consumption, or (2) for the purpose of resale at prices in excess of prevailing market prices of "materials * * * designated * * * as scarce materials * * *."

On December 29, the Defense Minerals Administration declared[74] tungsten ores and concentrates to be "scarce materials."

On January 22, 1951, the National Production Authority issued an order[75] (1) prohibiting the use of tungsten in certain specific products, (2) requiring the use of substitutes where they "will meet the requirements for the use to be made of such product or material," (3) limiting the use of high-speed steel of high tungsten content, (4) placing tungsten semifinished products under allocation, and (5) further restricting the amount of tungsten semifinished products that can be held in inventory.

The Defense Minerals Administration placed tungsten ores and concentrates of 40 percent and above and tungsten trioxide under allocation by an emergency order[76] issued February 13, 1951. On April 5, 1951, another order was issued[77] which placed all tungsten ores and concentrates containing 20 percent or more tungsten trioxide under allocation control and required every person holding 50 pounds or more to make monthly inventory reports.

(*b*) *Increased domestic production.*—The need to increase domestic production was obvious. Production in 1949 had fallen to below 3 million pounds, as compared with a peak of almost 12 million pounds in 1943.[78] Thus the potential output was clearly substantially in excess of current output.

Our reserves of tungsten, while small in relation to our needs, had nevertheless been estimated at over 117 million pounds recoverable, as of 1943, based on a cut-off grade of 0.5 percent which would be profitable to mine at a price of $30 per unit or less. In addition, it had been estimated that perhaps 24 million additional pounds of

[72] National Production Authority Regulation 1.
[73] National Production Authority Regulation 2.
[74] Defense Minerals Administration Order MO-1.
[75] National Production Authority Order M-30.
[76] Defense Minerals Administration Order MO-4.
[77] Defense Minerals Administration Order MO-6.
[78] While the Yellow Pine mine in Idaho, the largest producer in 1943, had been virtually exhausted, this had been partially offset by the development of a large mine in North Carolina, which had virtually no production in 1943.

contained tungsten were available in deposits which would require higher costs of operation.[79]

The agency primarily charged with stimulation of production, the Defense Minerals Administration, had a broad arsenal of powers. It could recommend loans or loan guaranties and procurement contracts at or above market prices to other agencies. It could also recommend levels at which price controls would be imposed.

The Defense Minerals Administration stressed the necessity of adequate incentives to domestic producers, mainly price.[80] All other programs or methods of stimulating output were apparently subordinated to the question of an increased price, as is indicated below.

(1) Price ceilings: Prior to January 27, 1951, there were no price controls on tungsten. Prices rose rapidly after the Korean incident. Domestic tungsten concentrates, which had been quoted at $28.50 per short-ton unit of WO_3[81] since late 1948, rose to a quoted level of $59 by January 11, 1951. Tungsten of foreign origin, which had been quoted at $21 to $22 per unit, prior to Korea, rose to a quoted level of $61 to $68 by January 11, 1951. On January 26, 1951, the Office of Price Stabilization issued its General Ceiling Price Regulation (under which tungsten also fell) which froze each seller at the highest price he had charged for deliveries made between December 19, 1950, and January 25, 1951.[82]

This price regulation, we have been informed, brought tungsten shipments to a virtual standstill. It was stated that this resulted from the fact that producers were frozen at different prices and processors, in a similar situation, were faced with tungsten costs in excess of their selling prices for finished products.

The Office of Price Stabilization recognized this situation and began immediately to prepare tailored regulations for tungsten products. However, almost 3 months transpired before clarifying regulations were issued. The main reason for this delay was a dispute between the Office of Price Stabilization and the Defense Minerals Administration over what price should be set for tungsten concentrates.

The Defense Minerals Administration at first urged a ceiling price of $70 per short-ton unit, arguing that this price was necessary to bring out low-grade ores.[83] The Office of Price Stabilization, Metals Branch, contended that it would be manifestly unfair to the taxpayers to give large low-cost producers huge windfall profits by establishing an excessively high ceiling price.[84] The Metals Branch felt that $55 was the price that should be set together with a subsidy for marginal ores, where necessary.[85] It was further pointed out that a high ceiling

[79] Minerals Yearbook, 1947, p. 1187. It should, of course, be recognized that some of the reserves available at the end of 1943 had been mined in the interim, but on the other hand, estimates of reserves in some areas had been increased as a result of further exploration and development. No later definitive reserve figures were available for the country as a whole. These data are reproduced as appendix E.

[80] Congress had already exempted profits derived from the mining of tungsten (and other strategic materials) from excess profits taxation.

[81] A short-ton unit is 1 percent of a short ton, or 20 pounds. A short-ton unit of WO_3 equals 15.86 pounds W, the W content of WO_3 being 79.3 percent.

[82] According to testimony before the Subcommittee on Mines and Minerals of the House Committee on Interior and Insular Affairs, tungsten concentrates were frozen at a range of $20 to $75 per short-ton unit or from about $1.25 to $4.70 per pound of tungsten.

[83] DMA argued that maximum production required mining to a cut-off grade of 0.4 percent.

[84] One of the points made by OPS officials was that the great bulk of our reserves were based on a cut-off grade of 0.5 percent which would have allowed for a profit at a $30 price in 1943. Based on changes in wage rates and wholesale prices, a $55 price early in 1951 was about equivalent to $30 in 1943. Incidentally, the highest price paid in 1943 to domestic mines under the World War II subsidy was $30.

[85] This was the type of program that was used in World War II.

price would not necessarily guarantee increased production and expansion of facilities, whereas a subsidy would condition payment on results.

The Defense Minerals Administration insisted on a ceiling price of $65 a short-ton unit, and opposed any subsidy plan because of anticipated administrative difficulties. They felt that the added cost of tungsten would be small compared with the cost of administering a subsidy plan. To the argument that a high ceiling price does not guarantee increased production, the Defense Minerals Administration replied that it had faith that the tungsten mining industry would expand.

The committee is informed that the Office of Price Stabilization and the Defense Minerals Administration were, at one time, agreed on a $55 ceiling plus a subsidy where necessary, but the Defense Production Administration, for reasons as yet unascertained, ruled that no subsidy program for tungsten would be authorized. Subsequently the $65 ceiling price was agreed upon, and established by Ceiling Price Regulation 19 on April 6, 1951. On May 8 the prices of tungsten intermediate products were fixed.

It should be noted that in the price order, the Office of Price Stabilization stated frankly that—

> unfortunately, very little data is available to measure with any degree of precision the ceiling price level necessary to bring about the required expansion and the exigency of the situation does not permit of any extended study—

and that—

> it has been determined after consultation with, and largely upon the advice of, the Defense Minerals Administration that a ceiling of $65 per short-ton unit will be adequate * * *.[86]

It is also interesting to compare the relation between this ceiling price and pre-Korean prices with the relation between World War II ceiling price and pre-World War II prices.

The World War II ceiling price to consumers was $24 a short-ton unit as compared with an average price of $23.41 in 1941, $20.61 in 1940, and $17.11 in 1939.[87] The 1951 ceiling price of $65 compares with $28.50 for the first 6 months of 1950, $28.50 for 1949, and about the same for 1948.[88]

These figures show that the World War II ceiling price was fixed at about the 1941 price level, reflecting an increase of about 40 percent above 1939 prices, as compared with a general wholesale price increase of about 25 percent. On the other hand, the 1951 ceiling price of $65 was more than double the pre-Korean prices, while the general wholesale price increase was only 11 percent between June 1950 and February 1951.[89]

(2) Floor price plan: In order to provide a guaranteed market to encourage the mining of tungsten, the Defense Minerals Administration on March 5, 1951, recommended to the Defense Production

[86] CPR 19.
[87] Metals Statistics 1950, published by American Metals Market.
[88] The $28.50 price is shown in appendix B. There are indications that sales were made at substantially lower prices before Korea.
[89] The increase in wholesale prices is cited as a rough guide to probable cost increases.

Administration that the Government agree to purchase all domestically produced tungsten for a period of 5 years at $63 a short-ton unit.

This program was certified on March 30, 1951, to the General Services Administration.

On April 20, Mr. Jess Larson, the Administrator of the General Services Administration, wrote back to Mr. Harrison of the Defense Production Administration, in part, as follows:

> The program as certified covers all domestically produced concentrates, which would include present production as well as increased production from existing sources and production from new mines. The purpose of the program is to obtain increased and new production, but it does not seem to be necessary to guarantee a minimum price of $63 in order to have production continue at the 1950 rate. This problem is pointed up by the case of the Tungsten Mining Corp. On March 2, 1951, the Secretary of the Interior recommended the execution of a contract with that company covering present and expanded production and providing a floor price of $43 per unit for the entire production * * *. It does not appear that a guaranteed price of $63 would be justified with respect to that portion of the company's production which is continued at the 1950 rate. It is therefore proposed to limit the Government's offer to new production and to production from existing sources above the 1950 rate, excluding production at the 1950 rate excepting in special cases approved by this Administration.

On April 21, the General Services Administration announced a 5-year purchase program covering only "newly discovered and developed ores" and "production above 1950 levels."

This announced program did not meet the approval of the Defense Minerals Administration for two principal reasons. First, it did not cover all tungsten produced, including only new and expanded production, and secondly, the Defense Minerals Administration had not proposed the use of Government purchasing depots.

In answer to an inquiry from the committee, the Defense Minerals Administration said [90] that it was opposed to restricting the program to new and expanded production "because of the impossibility of practically determining what would be new and expanded production."[91]

On May 10, the program was amended by the General Services Administration in accordance with the views of the Defense Minerals Administration.[92] The program now covers all tungsten produced.

In other words, if within the next 5 years the market price of tungsten falls below $63, the Government is obligated to buy at $63.

The program has one limitation, the Government is not obligated to buy more than 1,468,750 short-ton units or approximately 23,500,000 pounds. The Defense Minerals Administration advised the committee that this limitation was imposed because of budgetary limitations on the funds that could be allocated for the fiscal year ending June 30, 1951. This amount will presumably be increased to cover total expected production for 5 years when and if the author-

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[90] Letter to Donald C. Cook, dated May 1, 1951

[91] It will be noted that the original version of the floor-price program, cited above, gave the Administrator discretion in special cases to cope with special problems, such as those which Defense Minerals Administration had in mind.

[92] The Administrator of the General Services Administration advised Mr. Donald C. Cook in letter of May 16 that "we have, however, deferred to Dr. Boyd's insistence that it would be impossible to practically determine what would be new and expanded production." See appendix F.

ity for an increase in commitments is approved by the Congress and the President.[93]

It is interesting to note that this $63 price was established for all tungsten, even though for example, prior to the announcement of the floor program, the Tungsten Mining Corp., one of the three largest producers, was willing to sign a contract for both "present production as well as increased production from existing source, and production from new mines" at only $43 per short-ton unit.

In view of the above-described insistence of the Defense Minerals Administration for a $63–$65 5-year price for tungsten, bowling over the opposition of the Office of Price Stabilization and the General Services Administration, this committee was amazed to receive a letter[93a] from Dr. Boyd, Administrator, in which he admits that the "$65 price is considerably in excess of any floor price necessary to encourage the expanded production from projects we then had under consideration." These projects covered both mines already in production and mines yet to be put into operation. Referring to a specific project not yet in operation, Dr. Boyd said that it could profitably operate at $48 or less.

It appears obvious that this floor program will unnecessarily increase the cost of the preparedness program.

(3) Loans and loan guaranties: Since many small producers had been hard hit by the drop in demand (and price) for tungsten in 1949 and the first half of 1950, as exemplified by the closing of numerous small mines, it was only logical to expect that there would be numerous requests for loans, whether justified or not.[94] As of March 2, 1951, the committee was informed that 43 applications for loans and 5 applications involving purchase contracts had been received by Defense Minerals Administration,[95] and as of the date of this report no loans or contracts have yet been made or executed.

(4) Exploration and development loans: On February 20, 1951, the Defense Minerals Administration announced that the Defense Production Administration had allocated $10,000,000 "for use in stimulating exploration for strategic and critical materials needed in the defense program." The program provided for projects as to which both the Government and the private operator would contribute financially. The contribution of the Government depends on the mineral involved. In the case of tungsten the Government will contribute 75 percent of the cost of the project. The Government's share is repayable only out of the proceeds of the discovered metal or mineral. If no commercially producible ore is discovered there is no obligation to repay the Government.

This program was not put into operation until April 12 because of budgetary difficulties and as of the date of this report only one tungsten loan of this type has been made.

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[93] Subsequent to the preparation of this report, the committee was informed that the quantitative ceiling was raised to 3,000,000 short-ton units.

[93a] Letter dated June 5, 1951, to Donald C. Cook.

[94] Letter from Mr. H. A. Savage, president of the Tungsten Mining Association, to Senator Johnson, April 25, 1951, says in part, "Many small mines, and we think it fair to say most small mines, are broke. This is especially true of the tungsten miner. In order to increase production loans must be made."

[95] Letter to Donald C. Cook, chief counsel

(5) Appraisal of domestic production program: Since September 18, 1950, when the Defense Production Act became law, the following steps have been taken with respect to tungsten:

Orders have been issued and steps taken to police inventories of tungsten and its products and to conserve supplies by requiring substitution of other alloys for tungsten. While the committee has not made an exhaustive study of the accomplishments under this program, it is of the opinion that considerable progress has been made in conserving tungsten for its most essential uses.

On the other hand, the stimulation of domestic production has been disappointingly slow. Disagreements between defense agencies as to appropriate policy delayed the setting of price ceilings and price floors.

Two conflicting philosophies were apparent. The Defense Minerals Administration took the position that the most effective way of stimulating production was to set a high price, applicable to all production, whether from presently producing mines, old mines to be reopened, or entirely new mines. These high prices, $65 per short-ton unit as a ceiling and $63 as a floor, were predicated on the feeling "that this form of encouragement would do more to increase our supply immediately (from presently producing mines) than new ore which will be brought in by new producing properties due to a floor under the price of $63 per unit." [96]

The opposing school of thought, as exemplified by the Office of Price Stabilization and General Services Administration, felt that production would be stimulated more promptly and at a lower cost, if incentives to producers were selective and based on the necessities of particular situations. For example, the Office of Price Stabilization's view was that a ceiling price of $55 per unit would be adequate to encourage existing producers to produce at capacity, in view of the fact that the largest producers were operating at a profit before Korea on a price of $28.50 per unit or less. Office of Price Stabilization suggested, in addition, that a subsidy of $10 or more per unit be paid to producers for output in excess of a base period, say 1950 output, contending that this would make payment contingent on results and yet stimulate output.

The same attitude presumably animated the General Services Administration to modify the Defense Minerals Administration-Defense Production Administration proposal for a floor price program at $63 per unit to cover only production in excess of the 1950 rate in the original announcement.[97] The Defense Minerals Administration, however, opposed this limitation and succeeded in having General Services Administration defer to their view "that it would be impossible to practically determine what would be new and expanded production." [98] This committee is not convinced that such a deter-

[96] Letter from Mr. James Boyd, Administrator, DMA, to Donald C. Cook, Chief Counsel, May 7, 1951.

[97] In a letter dated April 20, 1951, to Mr. W. H. Harrison, Administrator, OPA, Mr. Jess Larson, Administrator, GSA, stated that the purpose of the order was "to obtain new and increased production, but it does not seem to be necessary to guarantee a minimum price of $63 in order to have production continue at the 1950 rate." Mr. Larson cites the case of one large producer who was willing to sign a contract covering present and expanded production at $43 per unit, as evidence.

[98] Letter from Jess Larson, Administrator, GSA, to Donald C. Cook, Chief Counsel, dated May 16, 1951.

mination would be impractical, in view of our own World War II experience.

The Defense Minerals Administration's philosophy is reflected in a letter to Mr. Harrison of Defense Production Administration, in which Dr. Boyd pointed out that "because of the relatively insignificant value of the total output and the end-uses of the material, the price of tungsten has no important bearing on the general economy or the cost of living." [99]

In this presentation, the Defense Minerals Administration overlooked the fact that the Defense Production Act states that one important purpose for price controls is—

> to assure that the defense appropriations are not dissipated by excessive costs and prices.[1]

Tungsten, by the very nature of its end-uses (such as artillery cores, jet engines, and cutting tools) is an ideal example of the product to which this criterion, in our opinion is meant to apply.

It would be premature to expect a prompt and sizable increase in production as a result of the stimulus of high prices. Mine shafts and tunnels must be excavated, mills built or expanded, machinery, equipment, and supplies must be procured and installed, an increased labor supply must be recruited, to name only a few conditions, other than price, which must be satisfied to expand production. Only time can tell whether the virtually complete dependence on price as an incentive, vigorously pushed by Defense Minerals Administration over the opposition of other agencies, will prove adequate to the manifold aspects of the problem of stimulating production.

On the other hand, Defense Minerals Administration has not yet taken some steps, which are its peculiar responsibility, to expand output. For example, during World War II, Government ore depots were established to buy ores and to consolidate them in large lots for shipping to mills and treatment plants. Moreover, the Government had built and operated for its account, a 100-ton per day treatment plant at Salt Lake City, Utah, which by all accounts, was a major factor in making possible high tungsten production. There is no indication that any steps have yet been taken since Korea to provide such facilities despite the recognition of their need.[2]

In conclusion, it would appear that the domestic production program to date has consisted merely of providing substantial monetary incentives. This program is based on a very high price, underwritten by the Treasury, and is in no way contingent upon performance by the recipients. It is costly, and holds no sure hope of success.

(c) *Foreign procurement.*—(1) Procedures under the Defense Production Act: Foreign procurement contracts under the Defense Production Act are processed like domestic contracts; they are recommended by Defense Minerals Administration to Defense Production Administration and certified by the latter organization to the General Services Administration.[2a]

The foreign loan procedure has not been crystallized by a definitive order. Pursuant to an understanding only, the Export-Import Bank

[99] Letter dated March 26, 1951.

[1] Title IV, Price and Wage Stabilization, sec. 401.

[2] Letter from Thomas H. Miller, Acting Director, U. S. Bureau of Mines, to Senator Johnson, dated February 6, 1951.

[2a] On March 5, 1951, the Defense Production Administration authorized the General Services Administration to utilize a revolving fund of $13,950,000 for the purchase of foreign tungsten. This authorization eliminated the necessity of certifying individual contracts not exceeding in total the $13,950,000. However, when the total committed exceeds this figure each contract will have to be processed as described above.

is referring loan applications, not meeting its statutory standards, to the General Services Administration for consideration of guaranties.

The Export-Import Bank advised the committee that the failure to adopt a definite procedure has led to uncertainty and confusion on the part of the agencies concerned. As early as December 20, 1950, the bank proposed the formal adoption of the procedure now being followed informally but no action has been taken.

(2) Procurement activities: The General Services Administration has made several contracts for tungsten under the Stockpiling Act. However, these are primarily long-range contracts and do not add to the supply currently needed in our defense program.

The Economic Cooperation Administration has concluded two production contracts in Portugal. The deliveries under these contracts are optioned to the stockpile. Other investigations are currently being made in other ECA areas with a view to increasing our supply of tungsten.

The great bulk of tungsten imports for current consumption is being handled by private importers under price conditions which handicap our preparedness program.

(3) Price problems: The prices of both foreign and domestic tungsten have increased very sharply since the Korean War. In part, the increase has been speculative in anticipation of a greatly increased demand. Prices in London, for example, rose to a level of over $80 per unit for a brief period, during the period of uncertainty as to United States prices, but by the end of March, prices in London had receded to $67.50 per short-ton unit. One reason ascribed for the decline was "a report to the effect that the British Ministry of Supply will take over the purchase and sale of tungsten ore, caused the break." [3]

Foreign prices, under the spur of such speculation, were well above domestic prices. New purchases of foreign tungsten virtually ceased, because importers could not afford to pay these prices and sell at the lower ceilings, established under the general ceiling price regulation issued January 26, 1951.[4] The resulting price problem has been described as follows:

> As for imports, the present price ceilings may inhibit imports of a number of metals and minerals where prices in foreign markets are above domestic prices. We are faced with the choice of either (1) holding to the ceilings and losing some part of the imports, (2) raising ceiling prices or exempting these metals from price controls, making price control on further fabricated products difficult, if not impossible, or (3) arranging for governmental purchase and resale of imported metals and minerals at a loss, if necessary, to help stabilize prices.[5]

After the issuance of Ceiling Price Regulation 19, on April 6, 1951, which set a uniform ceiling price of $65 per short-ton unit, prices in London eased, indicating that the United States price level for tungsten influenced London prices significantly and that the earlier price rise was, in good measure, speculative. During April and May, London prices have fluctuated in a much narrower range than in the two preceding months, doubtless reflecting the stability and level of price established in the United States. Had the price ceiling and floor in the United States been set at lower levels, it is likely that the foreign price would have declined further without adversely affecting foreign production.

[3] E. & M. J. Metal and Mineral Markets, March 22, 1951.

[4] Under the GCPR, each importer was forbidden to resell at a price higher than he realized during the base period, December 19, 1950, to January 26, 1951, when prices were lower.

[5] Statement by Sam M. Ewing, Chief, Metals Branch, Office of Price Stabilization, before Subcommittee on Mines and Mining of House Committee on Interior and Insular Offices, April 4, 5, 6, 1951.

It should, however, be noted that even when London and United States prices are equal, the private importer must necessarily incur these additional costs, the United States tariff of $7.93 per unit, plus shipping costs and a margin for his services. Thus the London price must fall well below $57 per unit to make private importation profitable under the $65 ceiling. Thus private importation for resale to consumers is still hampered because foreign buyers can outbid American importers in foreign markets since they are not for the most part restricted by price ceilings.[6]

It is difficult to comprehend why prompt and decisive steps were not taken to centralize tungsten imports in a single Government agency, as was done in World War II. Such a step would have enabled this Government to compete more effectively for imported supplies than could private importers, faced with the dual problem of an uncertain price on resale and the need to pay an import duty.

(4) World allocation: In recognition of the limited supplies of many metals and minerals available to the free world, a series of international conferences were held in Washington beginning late in February, including one covering tungsten and molybdenum, which began on March 8. The task of these committees was to collate the material which each country could furnish on its expected supply-requirements position in 1951 and later years, and to determine whether, and if so, upon what basis, the various nations of the free world would agree to expand output and to allocate the available supply. The committee has been informed that there are encouraging signs of progress along these lines, but it is recognized by all concerned that the total available supply is inadequate to meet their essential requirements.

We suggest that the agencies of the United States concerned should act on the principle that prompt efforts must be made to stimulate increased production of tungsten throughout the free world. The materials committee should be informed that such action is not intended to preempt supplies for the United States vis-à-vis the rest of the free world, but merely to facilitate the necessary increase in the supply available which will be shared on a fair and equitable basis. This suggestion is advanced solely because we feel that efforts to stimulate production abroad may have been retarded by an unwarranted belief that international allocation machinery, per se, would solve the tungsten supply problem. This obviously is not the case.

(5) Appraisal of foreign program: In view of the obvious free world shortage of tungsten,[7] there is a problem more fundamental than that of price or allocation inherent in a short supply situation. It is the need to stimulate foreign production. During World War II, both at home and abroad, prices were fairly tightly controlled and special incentives in the form of loans, with varying repayment provisions, were used to stimulate output. Furthermore, government-to-government contracts assured at least a short-term market at a fixed price.

In the present situation, the main reliance has been on a high domestic price [8] to stimulate foreign production. This reliance overlooks the useful function played by government-to-government con-

[6] On May 1, 1951, the Office of Price Stabilization ruled that imported tungsten when sold to any agency of the United States Government is exempt from price control.

[7] Some indications of the shortage are to be found in the rise in foreign tungsten prices, and the low level of production.

[8] During the last war, the highest price paid for foreign tungsten was about $24 a short-ton unit, while at present producers realize about $55 ($65 less the tariff of $7.93 and shipping costs) per unit.

tracts in World War II; for example, by virtue of these agreements, the United States was able to persuade governments to forego increases in export taxes, transportation rates, and to secure their assistance in moderating labor demands and in assuring relative freedom from labor disputes. Today, under the regime of private imports and high prices, none of these moderating forces are in operation. Consequently, the higher prices tend to heighten the inflation in these countries, by inspiring demands for higher taxes, higher wages, increased requirements for conversion of dollar exchange into local currency, all of which tend to reduce the margin of profit and to dull the incentive for increased production. Moreover, because there is no assurance relative to the future level of prices, new investment is rendered the more risky.[9]

This committee is of the opinion that so long as the responsibility for imports of tungsten and other strategic materials is not centralized in a single Government agency, there can be no certainty that imported supplies available to the United States will be adequate. Reliance on market fluctuations, subject as they are to speculative manipulation to assure needed imports, is a weak reed for our preparedness program. More use should be made of our Government's international bargaining power, e. g., one of our strongest assets, the power to make loans abroad has remained unused.[10]

This committee is convinced that the Defense Minerals Administration has neglected its duty to the Nation, by failing to formulate a comprehensive program to stimulate foreign tungsten production.[11]

Its intense preoccupation with the domestic aspects of its program has hampered our preparedness program. When it is recognized that this country has never been self-sufficient in tungsten, even in peacetime when consumption is relatively low, it is incomprehensible that the activities to stimulate and increase in tungsten output should have been so strikingly confined to the domestic scene.[12]

This committee strongly urges that the Office of Defense Mobilization as the agency with over-all responsibility have drawn up promptly a comprehensive program for the stimulation of foreign procurement and production of tungsten.

VII. Summary and Conclusions

Our Nation's tungsten position is little short of desperate.

Almost overnight, we have been cut off from our major sources of this metal which is so essential in peace and so vital in war. Those sources are the rich reserves of the Far East which we have lost through the Communist conquest of China, the bloody conflict in Korea, and the ceaseless guerrilla fighting in southeast Asia.

At the same time, our tungsten coffers, which should have been filled to the high water mark against just such a contingency, are down to the danger point. We face the lean years without the comforting fat we should have accumulated in the days of plenty.

The price we will pay for our sins of omission will be high—very high.

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[9] These considerations apply not only to tungsten, but also to stimulation of foreign production of other materials.

[10] As late as March 2, 1951, the DMA informed the committee "that the policy with respect to financing foreign expansion has not yet been finally determined."

[11] Other investigations by the committee indicate that the stimulation of foreign mineral production, in general, has been neglected.

[12] No responsible Government official, to our knowledge, has indicated a belief that domestic production could be increased sufficiently to meet even half our projected annual requirements.

We can increase our production; we can dip into our stockpiles; we can buy from what is left of the free world. But the harsh, inescapable fact is that we can foresee nothing short of a miracle that will produce enough tungsten for the combined essential needs of ourselves and our allies.

This gloomy picture flows in large part from the inexcusable failure of two agencies—both part of the same organizational set-up, both housed in the same building—to work together effectively in determining the requirements for tungsten in its largest military use—the core program. We are referring to the Munitions Board and the Department of the Army.

The facts of the situation are clear and unmistakable.

The Army had a program to develop high-velocity, armor-piercing shells with tungsten cores. These were the projectiles which had proven themselves in the Battle of the Bulge and upon which were based a large share of the military's antitank tactics.

At the same time, the Munitions Board was charged with the responsibility of piling up stocks of strategic materials to see this country through an emergency period. That responsibility was stated directly by Congress when it passed the Stockpile Act of 1946.

Meanwhile, the supplies of tungsten were available almost for the asking. Prices were either declining or, in periods when they were rising, rising much less rapidly than other strategic materials. China, with reserves which could supply the needs of the entire world, was under the control of a friendly government.

Nothing was needed but agreement—agreement and activity.

Yet, incredible as it may seem, these two agencies did not get together on the question. The Army neglected to tell the Munitions Board about its core requirements and the Board neglected to take any step to find out about it. Each acted as though the other were a distant—and somewhat unpopular—cousin.

This "see nothing, do nothing, speak nothing" attitude has jeopardized one of this country's more important defense programs—the development of armor-piercing shells.

During most of the period under discussion, the Munitions Board operated on the basis of stockpile objectives which were set in 1944 and bore no relationship to tungsten cores for shells. Even so, it made no purchase commitments until August 1948, and that commitment was grudging.

The 1944 objective was not changed until late in 1948 when a larger, though still inadequate, goal was set. But actually, the picture was still far from encouraging. The Board's efforts to stockpile tungsten were slow and halting and at no time did acquisitions catch up to schedules.

It is true that stockpile objectives were raised again in July 1950, and still again in November of the same year. But stockpile objectives are a far cry from stockpiles of tungsten. By the time realistic goals had been set, demand had risen and supply had fallen and the world market had experienced a sharp price increase.

In addition to bureaucratic blindness on the stockpile objectives, there are other reasons for our currently bad tungsten position. One was the failure of the Munitions Board to reexamine specifications. As a result, precious tungsten was rejected because it did not meet the standards of normal times. It was not until 6 months after the start of the Korean War that the Board advised GSA to buy lower-grade

metal which could be brought up to par by retreatment in the United States.

Another contributing factor was the failure of the Board to make up its mind upon the storing of semifinished products like ferrotungsten, metal powder, and carbide. For years, it had been advised by experts in the strongest possible terms to take this step. Yet, there was no attempt until October 1950, even to acquire the facts upon which an intelligent decision could be based.

While the Munitions Board dawdled idly over the tungsten stockpile, the Army played its own game of hide-and-seek with a potentially valuable proposal. It was the offer of a new process devised by Mr. K. C. Li, Wah Chang Corp., for the production of tungsten carbide.

Mr. Li, considered by many to be the outstanding expert in the tungsten field, stated that his process would save both tungsten and time in the manufacture of tungsten carbide. That was probably his great mistake. The Army may have been interested in saving tungsten, as we have no evidence to the contrary. But it certainly was not interested in saving time.

After 2½ years of study, the Army concluded that the samples submitted by Mr. Li were too small for conclusive results. It requested larger samples and, after an additional 6 months, came to the conclusion that the process was "economically undesirable."

The subcommittee is not fighting the battle for the tungsten carbide production process advanced by Mr. Li. But it does feel that on a subject matter of such great importance, it would have been possible to reach a conclusion in less than 3 years. It is doubtful whether we would have that much leeway on the battlefield.

The Li incident is typical of the slow, back and forth, up and down, in and out approach of the defense agencies to the challenge presented by the shortage of tungsten. It is difficult to discern anything resembling a program between the sluggish coils of bureaucratic red tape.

Taking into consideration all the circumstances, reasonable men would expect the United States Government to have a policy for stimulating both domestic and foreign production. However, reasonable men are frequently disappointed in their expectations. There is very little in the line of a well-rounded domestic program and less than that—in fact, nothing—in the line of a foreign program.

The domestic program is based primarily on the establishment of a high ceiling price of $65 a short-ton unit and a 5-year Government guaranteed floor plan of $63 a short-ton unit. Both the Office of Price Stabilization and the General Services Administration opposed the application of this price range to all mines but were unsuccessful in their efforts. Both ultimately had to capitulate to the views of the Defense Minerals Administration. The wisdom of their capitulation is open to question in view of the statement of Dr. Boyd, Administrator of the Defense Minerals Administration, in his letter of June 5 [13] that the "$65 price is considerably in excess of any floor price necessary to encourage the expanded production from projects we then had under consideration."

It is too early to pass final judgment on the effectiveness of the domestic program. But at a later date, the subcommittee will undertake a further survey to determine how the results compare with those achieved in World War II under more flexible policies.

[13] See footnote [12a], p. 31.

Apparently, the Defense Minerals Administration has been too preoccupied with domestic problems to formulate a foreign program. Purchases from abroad are on a hit-or-miss basis and conducted by a number of companies in no position to stimulate production. Furthermore, foreign prices are so high it has been almost impossible for any new purchases to be made within the limits of our ceiling prices. Undoubtedly, foreign prices have been kept higher than necessary to stimulate production abroad by our own high ceiling and floor prices. As a consequence, the cost of our preparedness program will have been increased unnecessarily for years to come.

The subcommittee believes that the failure to inaugurate a comprehensive foreign buying program has needlessly threatened our preparedness program. It is our opinion that steps should be taken at once to make the United States Government the sole importer of tungsten. Only thus could we coordinate our foreign buying with a view to an expansion of production through agreements with other governments.

VIII. Recommendations

The subcommittee recommends the following measures to be taken at the earliest practicable date:

1. That the Defense Department and other defense agencies concerned promptly take the necessary steps to reach a decision as to the feasibility of the Li process for making tungsten carbide.

2. That the Munitions Board immediately authorize the stockpiling of tungsten metal powder and tungsten carbide in quantities to be determined by (1) the deficiency of the processing facilities and (2) the decision as to the feasibility of the Li process for making tungsten carbide and other processes.

3. That the Defense Department aggressively pursue its research work for the development of armor-piercing projectiles which would require less tungsten than the present core projectiles.

4. That the Defense Minerals Administration determine whether the construction of custom mills and a chemical retreatment plant, similar to that constructed at Salt Lake City during World War II, is needed to maximize domestic tungsten output in usable form.

5. That the United States Government be made the sole importer and reseller of foreign tungsten and, in this connection, utilize to the extent possible the facilities and services of private persons and companies.

6. That to the fullest extent feasible all governmental activities in the development of sources and the procurement (including procurement for the stockpile) of foreign raw materials, including particularly minerals and metals, be centralized in, and the necessary operating funds be transferred to, a single Government agency, such as the Reconstruction Finance Corporation. This agency, in carrying out its functions, should consult and advise and coordinate its purchasing functions with the General Services Administration.

7. That the Office of Defense Mobilization promptly take steps to cause a comprehensive program, for the stimulation of foreign tungsten production and its procurement, to be formulated and placed into effect. Such a program should include, among other things, long-term contracts at fixed prices in exchange for positive actions by other governments leading to increased production.

APPENDIXES

Appendix A

World production of tungsten ores, by countries, 1905–48, in metric tons of concentrates containing 60 percent WO_3

[Figures for a few countries for certain years represent exports or shipments rather than production, and fiscal years rather than calendar years]

Year	North America					South America					
	Canada	Cuba	Mexico	United States	Total, North America	Argentina	Bolivia	Brazil	Chile	Peru	Total, South America
1905				728	728		68				68
1906				842	842	296	68				364
1907				1,488	1,488	460	454				914
1908				609	609	497	170	14			681
1909				1,469	1,469	817	152				969
1910	75			1,652	1,727	749	210			14	973
1911				1,033	1,033	679	336			52	1,037
1912	15			1,207	1,222	637	496			219	1,352
1913	11			1,394	1,405	575	297			324	1,196
1914				898	898	437	290			213	940
1915			140	2,116	2,256	169	859			413	1,441
1916			159	5,373	5,532	854	3,288	5	2	532	4,681
1917			308	5,574	5,882	1,085	4,215			427	5,727
1918	15		239	4,591	4,845	634	3,703			256	4,573
1919			103	297	400	204	2,161			139	2,504
1920			82	196	278	182	766			77	1,025
1921			37		37	52	174			2	228
1922						125	9				134
1923				219	219	144					144
1924				513	513	137					137
1925				1,080	1,080	4	82			5	91
1926				1,254	1,254	11	109				120
1927				1,056	1,056	10	79				89
1928				1,096	1,096	24	29				53
1929			11	753	764	63	1,630				1,693
1930			28	637	665	98	888				986
1931				1,274	1,274	20	410				430
1932				359	359	6	686				692
1933				812	812		240				240
1934			80	1,859	1,939	392	794			12	1,198
1935			54	2,173	2,227	579	1,423		7	57	2,066
1936			57	2,370	2,427	702	1,741		3	92	2,538
1937			33	3,175	3,208	866	1,802	6	18	78	2,770
1938			76	2,761	2,837	1,195	2,530	2	5	170	3,902
1939	4		229	3,889	4,122	1,309	3,337	7		170	4,823
1940	6	3	216	4,825	5,050	1,417	4,183	9		290	5,899
1941	32		191	5,957	6,180	1,720	4,353	35	1	337	6,446
1942	244	7	193	8,467	8,911	2,115	5,606	9		510	8,240
1943	618	7	516	10,836	11,977	2,390	6,902	1,264	3	722	11,281
1944	214		336	9,329	9,879	2,043	7,935	2,221	3	635	12,837
1945		9	134	5,020	5,163	1,067	3,851	2,192		523	7,633
1946			95	4,711	4,806	457	2,120	1,623		510	4,710
1947	375		97	2,807	3,279	33	2,635	1,329		579	4,576
1948	791		168	3,659	4,618	33	2,485	1,144		353	4,015
Total	2,400	26	3,582	110,358	116,366	25,207	73,566	9,860	42	7,711	116,386

World production of tungsten ores, by countries, 1905–48, in metric tons of concentrates containing 60 percent WO_3—Continued

Year	Europe											
	Austria	Czechoslovakia	France	Germany	Italy	Norway	Portugal	Spain	Sweden	U.S.S.R.	United Kingdom	Total Europe
1905	59	.....	25	38	33	.....	290	375	.....	.....	175	995
1906	57	.....	18	52	25	.....	571	201	.....	.....	276	1,200
1907	45	.....	61	62	16	.....	637	275	.....	.....	327	1,423
1908	40	.....	112	42	.....	.....	620	226	.....	.....	237	1,277
1909	39	.....	50	96	.....	.....	552	129	.....	.....	382	1,248
1910	49	.....	30	95	.....	.....	1,027	153	.....	.....	279	1,633
1911	45	.....	171	81	.....	.....	978	96	.....	.....	270	1,641
1912	66	.....	229	92	.....	9	1,330	183	.....	.....	196	2,105
1913	52	.....	160	96	.....	3	1,126	169	.....	.....	197	1,803
1914	57	.....	145	108	.....	5	667	135	.....	.....	222	1,339
1915	14	.....	126	193	.....	.....	953	189	.....	.....	360	1,835
1916	[1] 51	(1)	162	115	5	1	1,418	425	.....	34	407	2,618
1917	[1] [2] 50	(1)	261	295	1	1	1,580	446	.....	126	255	3,015
1918	[1] [2] 50	(1)	45	196	.....	2	1,150	534	3	25	307	2,312
1919	.....	70	70	145	.....	.....	706	302	30	5	177	1,505
1920	.....	48	23	45	.....	.....	237	57	5	1	83	499
1921	.....	35	.....	27	7	.....	306	25	.....	.....	81	481
1922	.....	28	.....	42	.....	.....	527	.....	.....	.....	3	600
1923	.....	28	.....	40	1	.....	289	9	.....	.....	2	369
1924	.....	66	.....	13	.....	.....	304	161	.....	.....	2	546
1925	.....	60	.....	161	.....	.....	207	26	.....	9	1	464
1926	.....	86	26	.....	.....	.....	358	123	.....	44	20	657
1927	.....	78	8	.....	.....	.....	174	164	.....	42	12	478
1928	.....	73	.....	.....	.....	.....	151	193	.....	58	96	571
1929	.....	75	1	.....	.....	.....	358	257	.....	(3)	27	718
1930	.....	74	.....	.....	.....	.....	499	254	.....	(3)	153	980
1931	.....	17	.....	5	.....	.....	274	135	.....	(3)	121	552
1932	.....	.....	.....	.....	.....	.....	272	43	.....	(3)	2	317
1933	.....	.....	.....	.....	.....	.....	358	46	.....	(3)	12	416
1934	.....	.....	.....	1	.....	.....	610	49	.....	(3)	223	883
1935	.....	.....	.....	.....	.....	.....	1,140	.....	.....	(3)	256	1,396
1936	.....	.....	.....	.....	.....	.....	1,414	.....	62	(3)	221	1,697
1937	.....	.....	.....	.....	3	3	2,069	250	127	(3)	148	2,600
1938	.....	.....	22	.....	4	19	2,810	215	180	(3)	258	3,508
1939	.....	.....	284	.....	2	31	3,851	368	158	[2] 300	188	5,182
1940	.....	.....	138	.....	2	10	4,858	393	145	[2] 500	201	6,247
1941	.....	.....	120	.....	1	8	5,834	415	228	[2] 500	127	7,233
1942	.....	.....	95	.....	5	7	5,220	1,462	267	[2] 700	198	7,954
1943	.....	.....	126	.....	2	.....	7,477	3,902	290	[2] 900	237	12,934
1944	.....	.....	84	.....	2	4	4,088	2,393	335	[2] 1,000	350	8,256
1945	.....	.....	185	.....	6	5	.....	283	413	[2] 1,300	120	2,312
1946	.....	.....	286	.....	.....	.....	630	431	490	[2] 1,500	108	3,445
1947	.....	.....	391	.....	.....	.....	3,149	461	322	[2] 1,500	68	5,891
1948	.....	.....	563	.....	.....	.....	2,930	888	317	[2] 1,500	[2] 70	6,268
Total	[4] 674	[4] 738	4,017	2,040	115	108	63,999	16,841	3,372	[5] 10,044	7,455	109,403

[1] Figures for Czechoslovakia included with Austria.
[2] Estimate.
[3] Data not available; no estimate included in total.
[4] Some production for Czechoslovakia included with Austria.
[5] Excludes production for 1929–38.

World production of tungsten ores, by countries, 1905–48, in metric tons of concentrates containing 60 percent WO_3—Continued

Year	Africa									
	Belgian Congo	Egypt	French Morocco	Nigeria	Southern Rhodesia	Southwest Africa	Tanganyika	Uganda	Union of South Africa	Total Africa
1905										
1906					8					8
1907					191					191
1908					36					36
1909					14					14
1910										
1911										
1912										
1913					5					5
1914										
1915					1					1
1916					2				2	4
1917					11				18	29
1918					37				37	74
1919				32	20				9	61
1920					17					17
1921					17					17
1922					44					44
1923										
1924					22					22
1925					22					22
1926										
1927					33					33
1928					15					15
1929					28					28
1930					38					38
1931					24				2	26
1932					14					14
1933					33	3				36
1934				5	117	18				140
1935				16	26	53	6		11	112
1936				11	88	46	2		30	177
1937		193		9	275	41	2	2	40	562
1938		24	7	49	329	48	5	2	127	591
1939			4	237	270	50		2	100	663
1940	63	15		131	246	24	2		105	586
1941	123	43			264	116	1		142	689
1942	315	17		100	504	122	2	7	400	1,467
1943	467	42		75	806	174	3	33	430	2,030
1944	433	16	3	30	757	118		95	660	2,112
1945	513			6	287	4		92	452	1,354
1946	397			5	53			102	144	701
1947	670			4	26	10		139	91	940
1948	236	15		4	80	12		126	151	624
Total	3,217	365	14	714	4,760	839	23	600	2,951	13,483

World production of tungsten ores, by countries, 1905–48, in metric tons of concentrates containing 60 percent WO_3—Continued

Year	Asia									
	Burma	China	French Indochina	India	Indonesia	Japan	Korea	Malaya	Thailand	Total Asia
1905						43				43
1906						43		137		180
1907					5	64		81	9	159
1908					23	200		75		298
1909				6	22	265		90		383
1910	369		17	21	30	250		95		782
1911	1,015					260		186	182	1,643
1912	1,901		74		26	204		323	181	2,709
1913	1,572		127		6	257		362	280	2,604
1914	2,106	18	162		1	204		460	273	3,284
1915	2,464	35	333		6	389	67	488	432	4,214
1916	3,464	109	343	46	47	730	555	884	530	6,708
1917	4,226	1,361	433	68	8	763	919	1,171	726	9,675
1918	4,138	10,577	378	44	7	629	1,100	1,547	231	18,651
1919	3,623	2,654	284	1		574	197	1,288	258	8,879
1920	2,983	4,712	284		161	170	5	553	137	9,005
1921	673	2,657	452		80			72	76	4,010
1922	1,038	3,873	112				14	362		5,399
1923	960	4,554	129		10			434		6,087
1924	814	3,398	150		165			321		4,848
1925	849	6,708	189		27			425	127	8,325
1926	1,634	7,989	92		9	19		333	10	10,086
1927	1,277	5,666	213		22	49	5	192	8	7,432
1928	843	8,283	175		8	54	161	144		9,668
1929	1,484	9,978	198		10	61	15	513	62	12,321
1930	2,699	9,454	220		15	81	13	1,232	7	13,721
1931	2,474	7,492	248		1	56	17	703	12	11,003
1932	2,226	2,249	247			22	62	553		5,359
1933	3,056	6,000	250			31	144	1,279		10,760
1934	3,913	5,099	300		1	70	399	2,011	36	11,829
1935	4,527	7,998	417		1	96	949	2,035	82	16,105
1936	5,382	7,638	503		1	61	1,849	2,037	82	17,553
1937	6,894	17,895	648	15		206	1,590	1,356	221	28,825
1938	7,090	13,387	545	12		300	2,625	1,082	251	25,292
1939	7,824	12,871	507		2	299	3,969	587	378	26,437
1940	8,095	10,141	390	44		479	4,525	522	400	24,596
1941	8,300	13,538	333	77		601	4,650	56	961	28,516
1942	1,346	12,962	213	87		817	6,062	61	1,653	23,201
1943	1,346	9,734	107	85		733	6,932	146	1,738	20,821
1944	1,346	3,502	83	33		575	8,402	217	1,135	15,293
1945		2,929	8	22		193	1,513	29	461	5,155
1946		2,691		3		59	1,180	10	201	4,144
1947	1,045	6,900				19	2,202	50	486	10,702
1948	1,824	12,200				9	[2] 2,245	87	495	16,860
Total	106,880	237,252	9,164	564	694	9,935	52,366	24,589	12,121	453,565

[2] Data not available; no estimate included in total.

World production of tungsten ores, by countries, 1905–48, in metric tons of concentrates containing 60 percent WO_3—Continued

Year	Oceania								Total world
	Australia						New Zealand	Total Oceania	
	New South Wales	Northern Territory	Queensland	Tasmania	Victoria	Western Australia			
1905	228	64	1,435	33			58	1,818	3,652
1906	245	208	785	20		1	110	1,369	3,963
1907	409	160	638	42		4	139	1,392	5,567
1908	244	36	468	5	3		79	835	3,736
1909	391	44	616	18	14	1	71	1,155	5,238
1910	375	71	1,039	68	28	2	169	1,752	6,867
1911	465	64	680	78	30	11	167	1,495	6,819
1912	270	40	856	79	12		164	1,421	8,809
1913	200	32	533	81	1	1	262	1,110	8,123
1914	221	45	401	56		1	242	966	7,427
1915	99	36	642	112			230	1,119	10,866
1916	313	137	519	126	17	5	306	1,423	20,966
1917	268	252	471	286	28	1	235	1,541	25,869
1918	279	280	357	440	5	6	170	1,537	31,992
1919	237	278	344	379	3	8	146	1,395	14,744
1920	39	245	119	209	9	3	47	671	11,495
1921			5	12			46	63	4,836
1922		19	4	21				44	6,221
1923	2	1		116			15	134	6,953
1924	10		1	64			18	93	6,159
1925	8		5	207			36	256	10,238
1926			1	98			15	114	12,231
1927			3	176			15	194	9,282
1928			29	209			6	244	11,647
1929	25	21	22	180			39	287	15,811
1930	17	67	24	133			21	262	16,652
1931	62	29	3				6	100	13,385
1932	27	15	8				9	59	6,800
1933		13	14	123			19	169	12,433
1934	59	89	41	230			39	458	16,447
1935	63	126	27	275			61	552	22,458
1936	18	141	22	245			49	475	24,867
1937	66	345	110	345			28	894	38,859
1938	124	480	193	400			54	1,251	37,381
1939	117	342	93	477			49	1,078	42,305
1940	76	314	129	607			88	1,214	43,592
1941	95	333	137	577			79	1,221	50,285
1942	52	159	217	475			73	976	50,749
1943	75	193	177	463			121	1,029	60,072
1944	53	102	229	300			159	843	49,220
1945	53	140	155	800			37	1,185	22,802
1946	42	74	75	850			30	1,071	18,877
1947	45	103	82	902			24	1,156	26,544
1948	28	72	96	1,031			28	1,255	33,640
Total	5,400	5,170	11,805	11,348	150	44	3,759	37,676	846,879

Accumulative world production of tungsten ores, by countries, 1905–48

Country	Metric tons, 60 percent WO_3	Percent of world total
North America:		
Canada	2,400	0.29
Cuba	26	(1)
Mexico	3,582	.42
United States	110,358	13.03
Total	116,366	13.74
South America:		
Argentina	25,207	2.98
Bolivia	73,566	8.69
Brazil	9,860	1.16
Chile	42	(1)
Peru	7,711	.91
Total	116,386	13.74
Europe:		
Austria, Czechoslovakia	1,412	.17
France	4,017	.47
Germany	2,040	.24
Italy	115	.01
Norway	108	.01
Portugal	63,999	7.56
Spain	16,841	1.99
Sweden	3,372	.40
U. S. S. R.	[2] 10,044	1.19
United Kingdom	7,455	.88
Total	[3] 109,403	12.92
Africa:		
Belgian Congo	3,217	0.38
Egypt	365	.04
French Morocco	14	(1)
Nigeria	714	.09
Southern Rhodesia	4,760	.56
South-West Africa	839	.10
Tanganyika	23	(1)
Uganda	600	.07
Union of South Africa	2,951	.35
Total	13,483	1.59
Asia:		
Burma	106,880	12.62
China	237,252	28.02
French Indochina	9,164	1.08
India	564	.07
Indonesia	694	.08
Japan	9,935	1.17
Korea	52,366	6.18
Malaya	24,589	2.91
Thailand	12,121	1.43
Total	453,565	53.56
Oceania:		
Australia	33,917	4.01
New Zealand	3,759	.44
Total	37,676	4.45
World total	[3] 846,879	100.00

[1] Less than 0.01 percent.
[2] Excludes production for 1929–38.
[3] Excludes production in U. S. S. R. for 1929–38.

Appendix B

Price of tungsten per short-ton unit of WO_3, Jan. 2, 1947, to Jan. 11, 1951

Date	Domestic	Foreign
1947—Jan. 2	$24.00	$21.00–$24.00
Mar. 20	25.00	25.00–27.00
Apr. 17	$26.50–27.50	26.00–28.00
May 8	27.50–28.50	28.00–29.00
May 22	28.00–30.00	28.00–31.00
June 5	28.00–30.00	29.00–31.00
June 19	30.00	30.00–31.00
June 26	30.00	30.00–33.00
July 10	32.00	31.00–33.00
July 17	32.00	32.00–33.00
Aug. 21	31.00	30.00–31.00
Sept. 11	30.50	30.00–31.00
Oct. 2	30.00	29.50–30.00
Oct. 16	30.50	30.00–31.00
Oct. 30	30.00	29.00–30.00
Nov. 6	30.00	28.00–30.00
Nov. 27	28.00–29.00	27.00–28.00
1947—Dec. 4	28.00–30.00	27.00–28.00
Dec. 18	28.00–30.00	27.00–30.00
Dec. 25	30.00	28.00–30.00
1948—Jan. 22	30.00	29.00–30.00
May 6	30.00	26.50–28.00
May 13	30.00	28.00–30.00
May 20	30.00	26.00–28.00
May 27	30.00	25.00–27.00
June 17	28.00	25.00–26.00
July 1	28.00	24.50–26.00
July 15	28.00	24.25–25.00
Aug. 19	28.00	24.00–24.50
Aug. 26	28.00	23.50–24.50
Sept. 9	28.00	23.50–24.00
Oct. 7	28.00	24.00–24.75
Nov. 4	28.50	24.00–24.75
Dec. 2	28.50	24.25–24.75
1949—Jan. 6	28.50	24.50–25.00
Feb. 24	28.50	24.75–25.25
Apr. 7	28.50	24.00–24.50
Apr. 28	28.50	24.00–24.25
May 26	28.50	23.00–23.50
June 23	28.50	23.00–23.25
1949—July 14	$28.50	$22.50–23.00
July 28	28.50	22.50–22.75
Aug. 4	28.50	22.00–22.50
Aug. 11	28.50	22.00–22.25
Aug. 25	28.50	21.00–22.00
Sept. 1	28.50	19.00–21.00
Sept. 15	28.50	18.00–20.00
Oct. 6	28.50	18.00–19.00
Oct. 27	28.50	18.50–19.50
Dec. 22	28.50	18.50–19.00
1950—Jan. 5	28.50	17.50–18.00
Mar. 2	28.50	17.75–18.25
Mar. 16	28.50	19.00–19.25
Apr. 20	28.50	18.75–19.25
May 11	28.50	18.50–19.00
May 18	28.50	19.00–19.50
May 25	28.50	19.50–20.00
June 15	28.50	21.00–21.50
June 22	28.50	21.00–22.00
July 6	28.50	21.50–22.00
July 13	28.50	23.00–23.50
July 27	28.50	24.00–24.50
Aug. 3	28.50	24.50–24.75
Aug. 17	28.50	25.00–25.50
Aug. 24	28.50	29.00–29.50
Aug. 31	32.00	29.00–30.00
Sept. 7	32.00	31.00–32.00
Sept. 21	[1] 36.00	34.00–34.50
Oct. 5	[1] 36.00	36.00
Oct. 12	[1] 38.00	38.00
Oct. 26	[1] 38.50	38.00–39.00
Nov. 23	[1] 39.50	39.00–40.00
Nov. 30	[1] 40.00	40.00–41.00
Dec. 7	[1] 47.00	44.00–45.00
Dec. 14	[1] 47.00	49.00–50.00
Dec. 21	[1] 47.00	54.00–56.00
Dec. 28	[2] 47.00	55.00–56.00
	[3] 56.50	
1951—Jan. 4	[2] 47.00	58.00–60.00
Jan. 4	[3] 56.50	
Jan. 11	[3] 59.00	61.00–68.00

[1] F. o. b. mine.
[2] Western.
[3] Henderson.

Appendix C

Metals Reserve Company,
Washington, D. C., May 8, 1942.[1]

Information Concerning Purchase of Domestic Tungsten Ores and Concentrates

Further to stimulate domestic production of tungsten, Metals Reserve Company, acting on recommendation of the War Production Board and with approval of the Office of Price Administration, announces that its present policy of purchasing domestic tungsten ores and concentrates on the basis of $24 per dry short ton unit of WO_3 will be continued in effect until December 31, 1943, upon the conditions prescribed herein. "Eligible producers" and "new producers" of tungsten may contract to participate in this program upon their compliance with the following conditions:

1. Definitions

An "eligible producer" is a domestic producer who in the year 1941 produced not less than 10 nor more than 100 short tons of 60 percent WO_3 concentrates, or tonnage of lower grade material having a recoverable content of not less than 600 nor more than 6,000 units of WO_3; a "new producer" is a domestic producer

[1] Revised.

who in the year 1941 produced less than 10 short tons of 60 percent WO_3 concentrates, or tonnage of lower grade material having a recoverable content of less than 600 units of WO_3; and both "eligible" and "new" producers must contract in writing with Metals Reserve Company to aid in supplying the increased requirements for war by producing tungsten at maximum capacity until December 31, 1943.

2. New York delivery (concentrates only)

Contracting producers desiring to sell domestic concentrates for New York delivery may do so upon the terms and conditions herein set forth. Metals Reserve Company will pay $24 per short ton unit, dry weight, of contained tungsten trioxide (WO_3) f. o. b. railroad cars, designated siding at the treatment plant of National Reconditioning Company, Glen Cove, Long Island, N. Y., or f. o. b. railroad cars at such other point in the New York area as Metals Reserve Company may designate, for domestic tungsten concentrates delivered in lots of one (1) ton or more meeting the following specifications:

Scheelite:		*Wolframite (huebnerite-ferberite)*
60 percent WO_3	percent	65.00
0.05 percent Cu	do	0.03
0.05 percent P	do	0.03
0.10 percent As	do	0.25
0.50 percent Bi	do	0.50
0.40 percent Mo	do	0.40
0.10 percent Sn	do	1.50
0.50 percent S	do	0.50
0.10 percent Sb	do	0.50
1.00 percent Mn		
0.10 percent Pb	percent	0.10

Tungsten concentrates containing the stipulated minimum tungsten trioxide (WO_3) content, but otherwise failing to meet the above specifications, will be penalized according to the following deductions from the base price, all penalties to be assessed pro rata for amounts in excess of specifications allowable, and at the following rates:

For each—	
0.01 percent of copper	10 cents per short ton unit of WO_3.
0.01 percent of phosphorus	Do.
0.10 percent of molybdenum	Do.
0.10 percent of sulfur	Do.
0.10 percent of lead	Do.
0.10 percent of arsenic	Do.
0.10 percent of antimony	Do.
0.50 percent of bismuth	Do.
0.10 percent of tin	Do.
1 percent of manganese [1]	Do.

[1] Scheelite only.

Tungsten concentrates containing less than the stipulated minimum amounts of tungsten trioxide (WO_3) will be accepted, subject to a schedule of penalties and treatment charges to be negotiated by the producer under special arrangements.

3. Salt Lake city delivery (ore or concentrates)

Contracting producers desiring to sell domestic tungsten ores, low or high grade domestic tungsten concentrates, middlings or tailings (herein sometimes collectively called "material") for delivery at the tungsten plant to be erected at Salt Lake City, Utah, may do so upon the terms and conditions herein set forth. United States Vanadium Corporation, 568 West Eighth South Street, Salt Lake City, Utah, will act as agent and operating manager of this plant for Metals Reserve Company. No penalties for impurities will be imposed at this plant.

A. *Price.*—(*a*) For material containing from 1 percent to 3 percent tungsten trioxide (WO_3, payment will be made for 85 percent of the contained tungsten trioxide (WO_3) at $24 per short ton unit, dry weight, f. o. b. railroad cars or trucks, designated siding or place, plant site, less a charge of $3 per short ton, dry weight, of material for milling and an additional charge of $3 per short ton unit, dry weight, of the tungsten trioxide (WO_3) content of the material to cover chemical treatment.

(*b*) For material containing more than 3 percent but not in excess of 15 percent tungsten trioxide (WO_3), payment will be made for 90 percent of the contained tungsten trioxide (WO_3) at $24 per short-ton unit, dry weight, f. o. b. railroad cars or trucks, designated siding or place, plant site, less the following treatment charges:

Contained tungsten trioxide (WO_3):	*Treatment charge per short dry ton*
More than 3 percent and not more than 4 percent	$30
More than 4 percent and not more than 6 percent	35
More than 6 percent and not more than 15 percent	40

In the event crude ore is delivered, there will be an additional charge of $2.50 per short dry ton of ore for grinding.

(*c*) For material containing in excess of 15 percent tungsten trioxide (WO_3), payment will be made for 90 percent of the contained tungsten trioxide (WO_3) up to and including 15 percent and for 100 percent of the contained tungsten trioxide (WO_3) above 15 percent, at $24 per short-ton unit, dry weight, f. o. b. railroad cars or trucks, designated siding or place, plant site, less treatment charges which must be obtained from the agent prior to delivery of such material.

B. *Quantity.*—Material may be delivered by such contracting producers as follows: Material containing from 1 percent to 3 percent tungsten trioxide (WO_3) will be accepted in lots of ten (10) tons or more; material containing in excess of 3 percent tungsten trioxide (WO_3) will be accepted in lots of one (1) ton or more.

C. *Shipment.*—Material will be received f. o. b. railroad cars or trucks, designated siding or place, plant site, Salt Lake City, Utah. Rail shipments must be consigned to United States Vanadium Corporation, agent for Metals Reserve Company, 568 West Eighth South Street, Salt Lake City, Utah, and producers must forward bills of lading and such information and advice regarding the shipment and arrival thereof as such agent may require. All freight charges will be for the account of the producer, provided that, where arrangements therefor have been previously made with such agent, shipments will be accepted freight charges collect and a deduction to cover such freight charges will be made on settlement sheet.

D. *Advances.*—Subject to the approval of such agent and Metals Reserve Company, such agent may, in certain instances, make advances to contracting producers in connection with the purchase of equipment necessary for the production of tungsten; any such advances to be against future deliveries by such producers to the plant.

4. Weighing, sampling, and analysis

Weighing, sampling, and analysis will be at the expense of Metals Reserve Company. Each shipment will be weighed, sampled, and analyzed on arrival. The weight of each shipment will be determined on scales and by a weighmaster designated by Metals Reserve Company. A weight ticket will be furnished for each shipment. Each shipment will be sampled and analyzed, including moisture determination, by an analyst designated by Metals Reserve Company. All final samples will be divided into four pulps which will be sealed in the presence of producer or his representative, if present. The producer or his representative will, upon request, receive one pulp; in the case of New York deliveries, Metals Reserve Company or its representative, and in the case of Salt Lake City deliveries, United States Vanadium Corporation, agent for Metals Reserve Company, will receive one pulp; two pulps will be filed by Metals Reserve Company, its New York representative or Salt Lake City agent, as the case may be, in a safe place. The Metals Reserve Company pulp will be analyzed. The producer, if he so desires, may have his pulp analyzed at his own expense by a reputable analyst satisfactory to Metals Reserve Company and may compare results with the results of analysis of the Metals Reserve Company pulp. Settlement may then be made by agreement, or one of the filed pulps may be analyzed by an umpire analyst mutually satisfactory to producer and Metals Reserve Company. The results of the umpire analysis must be accepted as basis for settlement by both the producer and Metals Reserve Company. The cost of the umpire analysis must be borne by the party whose analysis is further from the umpire analysis.

5. Payment

Promptly after analysis is obtained, including moisture determination, settlement sheet together with check in payment will be mailed to producer.

6. Rejection

Metals Reserve Company or its agents will reject any material which does not conform to the specifications set forth above. Any and all material rejected must be removed by producer within 15 days after mailing of notice of rejection. Any and all material not removed as above provided may, at the option of Metals Reserve Company or its agents, be removed or otherwise disposed of by Metals Reserve Company or its agents, without any liability therefor.

7. Effective period of program; termination provision

A. "*New producers.*"—With respect to contracting "new producers" the stipulated price will remain in effect until December 31, 1943.

B. "*Eligible producers.*"—As to contracting "eligible producers," stipulated price will remain in effect until December 31, 1943, except that Metals Reserve Company may, on or after December 1, 1942, at any time give notice of its intention to terminate this program 30 days from the date of the giving of such notice. In the event of such termination, Metals Reserve Company will, at its option, either—

(*a*) Accept from a contracting "eligible producer," f. o. b. same place and means of delivery theretofore used by such "eligible producer," a quantity of material derived from such producer's mine of the kind theretofore delivered by such producer, equal to such producer's "total unfilled production," and upon and subject to the provisions, requirements, and conditions of this circular, settle for such material on the basis of $24 per short-ton unit, dry weight, of tungsten trioxide (WO_3); or

(*b*) Settle in cash for such "eligible" producer's "total unfilled production" on the basis of $3 per short-ton unit, dry weight, of tungsten trioxide (WO_3).

Such "total unfilled production" shall be an amount of material of the kind theretofore delivered by such producer equivalent to such producer's average monthly production in short-ton units, dry weight, of tungsten trioxide (WO_3) for the six calendar months preceding the effective date of termination, multiplied by the number of months from the effective date of termination to December 31, 1943.

8. Other producers

Any domestic producer whose production in 1941 exceeded the highest quantities above mentioned will be afforded the opportunity to negotiate a contract with Metals Reserve Company on the general basis expressed herein, provided that such producer can demonstrate to the satisfaction of Metals Reserve Company that such arrangements are necessary to stimulate or maintain such producer's production of domestic tungsten.

9. Applications

To qualify as "eligible producers" or "new producers," respectively, application forms A or B, attached hereto, must be properly filled in and mailed to Metals Reserve Company, 811 Vermont Avenue NW., Washington, D. C.

FERRIS B. THOMAS,
Assistant Secretary.

Approved by Executive Committee, Metals Reserve Company, July 13, 1942.

Appendix D

National Stockpile Specification P–57
14 June 1950
(Supersedes issue of 6 March 1950)

General Services Administration,
Emergency Procurement Service,
Washington, D. C.

Material Purchase Specification

Tungsten

1. DESCRIPTION

This specification covers high-grade tungsten ores and concentrates of the following types:

A. *Ferberite.*—Defined as containing tungsten primarily as $FeWO_4$ with not more than 20 percent of the tungsten as $MnWO_4$.

B. *Hubnerite.*—Defined as containing tungsten primarily as $MnWO_4$ with not more than 20 percent of the tungsten as $FeWO_4$.

C. *Wolframite.*—Defined as containing tungsten as both $FeWO_4$ and $MnWO_4$ in any proportions from 80-percent $FeWO_4$ and 20-percent $MnWO_4$ to 20-percent $FeWO_4$ and 80-percent $MnWO_4$.

D. *Natural scheelite.*—Defined as containing, in nature, tungsten as $CaWO_4$.

E. *Synthetic scheelite.*—Defined as chemically precipitated scheelite produced from any natural type of ore.

2. CHEMICAL AND PHYSICAL REQUIREMENTS

(*a*) *Chemical requirements.*—Each lot of material purchased under this specification shall be of one of the five types listed in paragraph 1 and shall conform to the following chemical limits for that type:

	Percent by weight (dry basis)				
	Type A: Ferberite	Type B: Hubnerite	Type C: Wolframite	Type D: Natural scheelite	Type E: Synthetic scheelite
Tungsten trioxide (WO_3) ..... minimum	60.00	60.00	65.00	60.00	60.00
Tin (Sn) ..... maximum	.20	.25	1.50	.10	.05
Copper (Cu) ..... do	.10	.10	.05	.05	.05
Arsenic (As) ..... do	.15	.10	.25	.10	.05
Antimony (Sb) ..... do	.10	.10	.10	.10	.05
Bismuth (Bi) ..... do	1.00	1.00	1.00	.25	.25
Molybdenum (Mo) ..... do	.50	.50	.40	.40	.25
Phosphorus (P) ..... do	.07	.05	.05	.05	.05
Sulfur (S) ..... do	.50	.50	.50	.50	.40
Manganese (Mn) ..... do	1.00	(1)	(1)	1.00	.25
Lead (Pb) ..... do	.20	.20	.20	.10	.10
Zinc (Zn) ..... do	.10	.10	.10	.10	.10

[1] Not specified, but to be determined for each lot.

(*b*) *Physical requirements.*—Material of types A through D shall be either natural ore or concentrated produced from natural ore, and may be in the form of either lump or fines or a mixture of the two. Lumps shall not exceed 1 inch in size.

Type E material shall be chemically precipitated scheelite produced from any original type of ore, further processed such that not over 10 percent of any lot shall pass a 35-mesh Tyler standard screen.

3. PACKAGING

Material shall be packed in steel drums or hardwood barrels or kegs. Containers may be of any standard type, but all containers comprising a given lot shall be of the same nominal size and shape.

4. INSPECTION

Material shall be subject to inspection and analysis of each lot by the purchaser or its designee.

APPENDIX E

RESERVES [1]

The following information on reserves of tungsten ore in the United States was prepared by the Bureau of Mines and Geological Survey and is quoted from a report on Mineral Position of the United States, published in the hearings before a subcommittee of the Committee on Public Lands, United States Senate, Eightieth Congress, first session, 1947. It should be emphasized that the reserves were calculated on the basis of material that would be commercially profitable at costs prevailing as of 1943; consequently, allowance should be made for inflation, tariff changes, and other factors that have followed since the estimates were prepared.

Reserves of tungsten-bearing material estimated to be present in known deposits or districts in the continental United States are shown in the accompanying table. The reserves have been calculated on the basis of material that would be commercially profitable at $30, $24, and $16 per short-ton unit. The $30 price was the maximum premium price allowed by the Metals Reserve Company during the war to certain producers; $16 is a representative prewar price.

In the United States the price of tungsten ore is based upon the units of tungstic oxide (WO_3) per short ton. A short-ton unit is equivalent to 20 pounds of WO_3; ore containing 1 percent of WO_3 contains one unit to the ton. National statistics are often expressed in terms of pounds of contained metallic tungsten, 15.86 pounds being equivalent to one short-ton unit. Reserve estimates are given here in short-ton units of WO_3, with the approximate equivalent in pounds of contained metallic tungsten; gross and recoverable contents of the reserves are shown also.

In addition to the reserves shown in the table, residual or placer-type deposits may contain about 500,000 units of WO_3 (about 7,900,000 pounds of contained tungsten), which probably cannot be recovered profitably even at a price of $30 per unit of WO_3. Furthermore, 1,000,000 units of WO_3 are estimated to be contained in large, low-grade deposits and might be made available at a price somewhat above $30 per unit under conditions of large-scale operation.

Estimated tungsten reserves of the United States as of 1943, at $30 or less per short-ton unit of WO_3

Price per short-ton unit	Measured		Indicated	
	Gross	Recoverable [1]	Gross	Recoverable [1]
In short-ton units of WO_3:				
$16 or less [2]	300,000	216,000	800,000	576,000
$16–$24 [3]	500,000	360,000	1,300,000	936,000
$24–$30 [4]	600,000	432,000	2,000,000	1,440,000
Total	1,400,000	1,008,000	4,100,000	2,952,000
In pounds of contained tungsten:				
$16 or less [2]	4,758,000	3,425,800	12,688,000	9,135,300
$16–$24 [3]	7,930,000	5,709,600	20,618,000	14,844,900
$24–$30 [4]	9,516,000	6,851,500	31,720,000	22,838,400
Total	22,204,000	15,986,900	65,026,000	46,818,600

See footnotes at end of table, p. 52.

[1] Minerals Yearbook, 1947.

Estimated tungsten reserves of the United States as of 1943, at $30 or less per short-ton unit of WO_3—Continued

Price per short-ton unit	Inferred		Total	
	Gross	Recoverable [1]	Gross	Recoverable [1]
In short-ton units of WO_3:				
$16 or less [2]	1,400,000	1,008,000	2,500,000	1,800,000
$16–$24 [3]	900,000	648,000	2,700,000	1,944,000
$24–$30 [4]	2,500,000	1,800,000	5,100,000	3,672,000
Total	4,800,000	3,456,000	10,300,000	7,416,000
In pounds of contained tungsten:				
$16 or less [2]	22,204,000	15,986,800	39,650,000	28,547,900
$16–$24 [3]	14,274,000	10,277,300	42,822,000	30,831,800
$24–$30 [4]	39,650,000	28,548,000	80,886,000	58,237,900
Total	76,128,000	54,812,100	163,358,000	117,617,600

[1] Mining recovery estimated at 90 percent; milling recovery estimated at 80 percent.
[2] Lowest tungsten content of crude ore included in estimates, 0.8 percent of WO_3; average grade, 1.5 percent; minimum size of deposit considered, 10,000 units of WO_3.
[3] Lowest tungsten content of crude ore included in estimates, 0.6 percent of WO_3; average grade, 1.2 percent; minimum size of deposit considered, 5,000 units of WO_3.
[4] Lowest tungsten content of crude ore included in estimates, 0.5 percent of WO_3; average grade, 0.8 percent; minimum size of deposit considered, 500 units of WO_3.

APPENDIX F

GENERAL SERVICES ADMINISTRATION

OFFICE OF PUBLIC INFORMATION AND REPORTS

EXECUTIVE 4900, BRANCH 4511

For immediate release, Thursday, May 10, 1951 GSA–113

A regulation under which the General Services Administration will carry out a 5-year domestic-tungsten purchasing program to encourage the discovery, development, and production of tungsten in the United States was issued today.

Under the order, which interprets and implements the authority of Administrator of General Services Jess Larson to support the price of this critical metal at a base price of $63 per short-ton unit (dry weight) of contained tungsten trioxide, the guaranty will apply to specification-grade tungsten concentrates.

The purchasing program will be carried out by GSA in accordance with policy determinations made by Defense Minerals Administrator James Boyd, and certified to GSA by the Defense Production Administration.

The concentrate need not be produced from newly discovered or developed ores, but must be produced from domestic ores.

"While the support price applies to the purchase of concentrates, rather than ores, as previously announced, success of the program must depend on the participation of miners and prospectors," Mr. Larson said. "The anticipated increase in production will depend on the extent to which we can stimulate the flow of ores to mills where concentrates are produced."

In order to assist the miners and prospectors to dispose of ores, the Defense Minerals Administration will aid private operators in the establishment of milling facilities in tungsten-producing areas where such facilities are justified but not now available.

The regulation provides that "any operator of a concentrating plant by agreeing to participate in this program also agrees to purchase or process suitable tungsten contained ores offered to him by independent miners to the limit of the capacity of his plant, in excess of that required for his own production and on fair and equitable terms and conditions (including prices). Each operator of a concentrating plant participating in this program shall promptly establish a schedule setting forth his terms and conditions (including prices) for the purchase of crude tungsten ores. Each operator shall promptly submit a copy of such schedule to the Administrator, and shall also submit promptly any changes made in such schedule thereafter."

The Government will support the price by buying for $63 per short-ton unit all specification-grade tungsten concentrates which cannot be sold on the commercial market.

Funds now available for the support price allow for the purchase of 1,468,750 short-ton units over the 5-year period. It is not expected that the Government will be required to take physical possession of appreciable quantities of tungsten concentrates as the essential requirements of industry for the military and supporting programs are far in excess of anticipated production totals.

Notice of participation in the program must be postmarked or, in the case of a telegram, dated not later than midnight June 30 and be in the form of a letter, telegram, or penny post card addressed to the nearest GSA office.

Any person participating in the program will be sent promptly a certificate authorizing him to deliver concentrates meeting minimum specifications f. o. b. public carriers' convenancy, milling point.

Miners holding certificates, but who do not operate concentrating facilities, may participate in this program to the extent of the ore purchased by them, as follows:

1. By selling such ore to operators of concentrating plants.
2. By having ore treated on a toll basis and selling the resulting concentrates meeting specifications to GSA.

Existing milling facilities for tungsten concentrate are located as follows:

Colorado: Climax Mill, Climax; Wolf Tongue Mill, Nederland; Teal Mill, near Boulder.

Idaho: Ima Mill, Patterson, Lemhi County; Yellow Pine Mill, Stibnite, Valley County.

Montana: Henderson Gulch Dredge, Drummond, Mont.; Alps Mining & Milling Co., Missoula, Mont.

Nevada: Mill City Plant, Mill City, Pershing County; Toulon, Toulon, Pershing County; Golconda, Golconda, Humboldt County; Lindsay Mill, Minera. County; Nevada Scheelite Mill, Rawhide; Nevada Tungsten Corp., Sodaville; Gardnerville Mill, Gardnerville; Cherry Creek Mill, Cherry Creek; Getchell Mill, Golconda, Humboldt County; Minerva Mill, Minerva, White Pine County;

North Carolina: Tungsten Mining Corp., Henderson, Vance County.

New York: Wah Chang Plant, Glen Cove, Long Island.

Utah: H. M. & S. Milling Co., Salt Lake City.

Washington: Germania Mill, Fruitland, Stevens County.

Arizona: Tungsten Reef Mill, Hereford, Cochise County; Hillside Mill, near Bagdad.

California: Bishop District (near Bishop, Calif.): Pine Creek Mill of United States, Vanadium County; Tungsten Mill; Red Hill Mill; El Diablo Mill; Benware Concentrate Mill; Black Rock Mill; six minor mills now not in operation. Fresno-Madera-Tulare Counties: Harrel Hill, Dinuba; Tulare County Tungsten Mill, Lindsay; Garnet Dike Mill, Fresno County; Strawberry Mill, Madera County. San Bernardino County: Barker Mill, Atolia.

Miners and prospectors are asked to contact the Defense Minerals Administration or the nearest office of the Bureau of Mines if they find that milling facilities are not available to them.

(NOTE.—A copy of the regulation is attached.)

TITLE 32A—NATIONAL DEFENSE, APPENDIX

CHAPTER XIV—GENERAL SERVICES ADMINISTRATION

TUNGSTEN REGULATION; DOMESTIC TUNGSTEN PROGRAM

Sec.
1. Basis and purpose.
2. Definitions.
3. Participation in the Program.
4. Deliveries.
5. Duration of the Program.
6. Specifications and penalties.

AUTHORITY: §§ 1 to 6 issued under sec. 704, Pub. Law 774, 81st Cong. Interpret or apply sec. 303, Pub. Law 774, 81st Cong., sec. 303, E. O. 10161, Sept. 9, 1950, 15 F. R. 6105, 3 CFH, 1950 Supp.; sec. 2, E. O. 10200, Jan. 3, 1951, 16 F. R. 61; Defense Production Administration Certificate dated March 30, 1951.

§ 1 *Basis and purpose.* This regulation interprets and implements the authority of the Administrator of General Services to purchase tungsten concentrates of domestic origin for the fiscal years 1951–1956 as authorized by the Defense Production Administration on March 30, 1951, and outlines the attend-

ant responsibilities and functions of the Administrator of General Services in purchasing such tungsten concentrates for Government use and resale. In accordance with the Program set forth herein, the Administrator will buy domestically produced tungsten concentrates, at a base price of $63 per short ton unit of contained tungsten trioxide (WO_3), less penalties.

§ 2 *Definitions.* As used in this regulation:

(a) "Administrator" means the Administrator of General Services.

(b) "Program" means the program as set forth in this Regulation.

(c) "Milling point" means plant where ores are processed into specification grade tungsten concentrates.

(d) "Tungsten concentrates" means tungsten concentrates produced in the United States, its Territories and possessions from ores mined in the United States, its Territories and possessions.

(e) "Short ton unit" means one per cent of 2,000 pounds avoirdupois dry weight.

(f) "Ferberite" means concentrates containing tungsten primarily as $FeWO_4$ with not more than 20 per cent of the tungsten as $MnWO_4$.

(g) "Hubnerite" means concentrates containing tungsten primarily as $MnWO_4$ with not more than 20 per cent of the tungsten as $FeWO_4$.

(h) "Wolframite" means concentrates containing tungsten as both $FeWO_4$ and $MnWO_4$ in any proportions from 80 per cent $FeWO_4$ and 20 per cent $MnWO_4$ to 20 per cent $FeWO_4$ and 80 per cent $MnWO_4$.

(i) "Scheelite" means concentrates containing, in nature, tungsten as $CaWO_4$.

(j) "Synthetic Scheelite" means chemically precipitated scheelite produced from any natural type of ore, and shall be chemically precipitated scheelite produced from any original type of ore, further processed so that not over ten per cent of any lot shall pass a 35-mesh Tyler Standard Screen.

§ 3 *Participation in the Program.* (a) Any person may participate in the Program by notice given to the nearest General Services Administration regional office, in the form of a letter, postcard or telegram postmarked or dated by the telegraph office not later than June 30, 1951. Such notice shall state that the writer desires to participate in the Program and will either prospect for or produce tungsten, but the giving of such notice will not permit the participant to deliver material in any form other than that of concentrates meeting minimum specications. Such notification must be signed and a return address given. Any person participating in the Program will promptly be sent a certificate authorizing him to deliver concentrates meeting minimum specifications f. o. b. carriers conveyance, milling point. Miners holding certificates but who do not operate concentrating facilities may participate in this program to the extent of the ore produced by them, as follows:

(1) By selling such ore to operators of concentrating plants, in which event the resulting concentrates meeting specifications may be sold by such operators to the Administrator under this Program; or

(2) By having such ore treated on a toll basis and selling the resulting concentrates meeting specifications to the Administrator under this Program.

(b) Any operator of a concentrating plant by agreeing to participate in this Program also agrees to purchase or process suitable tungsten contained ores offered to him by independent miners to the limit of the capacity of his plant in excess of that required for his own production and on fair and equitable terms and conditions (including prices). Each operator of a concentrating plant participating in this Program shall promptly establish a schedule setting forth his terms and conditions (including prices) for the purchase and processing of crude tungsten ores. Each such operator shall promptly submit a copy of such schedule to the Administrator, and shall also submit promptly any changes made in such schedule thereafter.

§ 4 *Deliveries.* Tungsten concentrates purchased under the Program are to be delivered f. o. b. carriers conveyance any milling point designated by the Administrator. Delivery of less than one short ton of concentrates will not be accepted. In the event any delivery is less than the minimum weight required to obtain the lowest transportation rate, the difference between the lowest transportation rate and the rate paid by the Government shall be a charge against the seller and a proper adjustment therefore shall be made in the minimum base price. Each delivery will be analyzed by the Government after beneficiation at the milling point, and payment will be made in accordance with such analysis.

Deliveries not conforming to minimum specifications will be rejected and any expenses in connection therewith will be borne by the seller.

§ 5 *Duration of the Program.* The Program shall terminate and be of no further force or effect when 1,468,750 short ton units of tungsten have been delivered to and accepted by the Government under this Program, or on July 1, 1956, whichever occurs first.

§ 6 *Specifications and penalties.* (a) The specifications for tungsten concentrates and penalties applicable to deliveries of such concentrates appear below:

(1) Percentage of tungsten trioxide (WO_3) required with respect to each of the following:

	Ferberite	Hubnerite	Wolframite	Scheelite and/or Synthetic Scheelite
Standard	65%	60%	65%	60%
Minimum	55%	55%	60%	55%

(2) Maximum percentage allowances of the following elements without penalty:

		Ferberite	Hubnerite	Wolframite	Scheelite and/or Synthetic Scheelite
Tin (Sn)	Max	0.20%	0.25%	1.50%	0.10%
Copper (Cu)	do	0.10	0.10	0.05	0.05
Arsenic (As)	do	0.15	0.10	0.25	0.10
Antimony (Sb)	do	0.10	0.10	0.10	0.10
Bismuth (Bi)	do	1.00	1.00	1.00	0.25
Molybdenum (Mo)	do	0.50	0.50	0.40	0.40
Phosphorus (P)	do	0.07	0.05	0.05	0.05
Sulphur (S)	do	0.50	0.50	0.50	0.50
Manganese (Mn)	do	1.00	(*)	(*)	1.00
Lead (Pb)	do	0.20	0.20	0.20	0.10
Zinc (Zn)	do	0.10	0.10	0.10	0.10

*Not specified.

(b) The minimum base price shall be subject to the following adjustments:

(1) For each short ton unit of delivered tungsten trioxide (WO_3) the sum of twenty cents ($.20) shall be deducted from the base price for each one per cent of tungsten trioxide (WO_3) below the standard requirements set forth in subparagraph (a) of this Section. No tungsten concentrates not meeting the minimum requirements set forth in said subparagraph (a) will be accepted.

(2) For each short ton unit of delivered tungsten trioxide (WO_3) a deduction of twenty-five cents ($.25) shall be made for each of the following increments in excess of the maximum allowances (subparagraph (a)), as to each of the following elements:

0.01%	Copper (Cu)	0.10%	Tin (Sn)
0.01	Phosphorus (P)	0.10	Sulphur (S)
0.10	Arsenic (As)	0.10	Antimony (Sb)
0.50	Bismuth (Bi)	1.00	Manganese (Mn)
0.10	Molybdenum (Mo)	0.10	Lead (Pb)

Dated:

JESS LARSON, *Administrator.*